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CHEMICAL AGE

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NEW LIFE FOR GAS

WITH the advent of atomic power, many believed the gas era was drawing to a close. That this is not so is to be seen from news of successful research projects leading to more and more economic commercial gasification plants.

One of the principal objects of the Gas Council's research programme is the development of new processes for the economic manufacture of gas. Elsewhere in this issue (see p. 629) we outline the work of the Council's Midland Research Station at Solihull, Warwickshire, which was opened on Tuesday by Sir Cyril Hinshelwood, president of the Royal Society. At this station are investigated processes for the complete gasification of low grade coals, which previously have been discarded as being unsuitable for gas making.

One of the best ways of using low grade coal, or for that matter any coal, is to gasify it near the mines. Transport costs are avoided and a higher efficiency of burning gas is obtained. With increased modernisation and mechanisation of mines, very poor coals of high ash content can be mined and with new treatment process, can provide suitable gas. This gasification of low grade coals thus opens up a very great opportunity for the British gas industry, with gas being produced in a limited number of super-stations near the mines and being distributed through a grid system. In fact, the gas service now being planned for this country could well place it in the forefront of those countries which are dependent on coal.

These developments call, however, for considerable research as a new type of gas-making process is required. The coal carbonisation process is unsuitable as it depends for its economics on producing coke as well as gas. The ash in low grade coals rules out the possibility of coke being produced. The only type of process suitable for the low grade coals is one in which the combustible matter is completely converted in gas—a 'gasification' process in which three times as much gas per ton of coal is produced compared with the 'carbonisation' process.

As gasification has only been used on a limited scale in an auxiliary capacity, considerable research and development work is required to enable gasification processes to treat any kind of coal, and to produce a higher quality gas than previously (low in carbon monoxide and sulphur-free), while appliances and plants must have great efficiency and flexibility and be capable of very precise control.

The Solihull research station is investigating gasification processes, particularly the pressure gasification process. The pressure inside the vessels in which the gas is made and purified is 'some hundreds of pounds per square inch.' Such high pressures have been adopted for a number of reasons. Pressure facilitates rapid gasification of small coal and enables plant units to have the high capacity required for super-stations. Output will compare with the present larger gasworks.

Research at Solihull has shown that the use of pressure corrects lower calorific value by reacting hydrogen with the coal. In fact, due to this hydrogenation process the calorific value of town gas will be increased above its present value. The use of pressure also assists in obtaining high purity gas,

and in enabling gas of the same composition to be produced from quite different raw materials. The pressure processes will therefore open up the way to a greater uniformity of gas supplies in different parts of this country and so assist in the manufacture of gas appliances.

Not only does the pressure process aid purification of the gas, it also assists in the up-grading of by-products since these are also of high quality. Also ways have been developed for treating effluent wastes from the processes, so that no objectionable effluents, either gaseous or liquid, will be produced or discharged.

A further advantage of the pressure processes, the Gas Council show, is that distribution of the gas costs less as the gas is already under pressure and requires no compression. Also avoided are compression costs when, at times of reduced demand, surplus gas is used for making chemicals and liquid fuels.

From research at Solihull it has been concluded that the best type of pressure process for super-stations is that using powdered coal so that with 'fluidised' techniques, the maximum control is obtained over the chemical reactions. Powdered coal will be treated under pressure, first with hydrogen to produce by-products and the rich constituent of the final gas. Solid residue from the hydrogenation will then be gasified to completion in oxygen and steam. It is believed that this two-stage process can be developed to meet all requirements and to test this belief a pilot-scale plant is being erected at Solihull.

In addition to experiments on this fluidised process, however, the research station is also carrying out investigations on the best of available pressure processes so that these may be available for immediate installation. Having regard to the importance of overall economy of gas supply, supplementary processes specially designed for peak loads are under study. In particular, pressure processes for gasifying oil are being developed, since oil is now readily gasified and less plant is required in operation. An important point here is that besides the plant being relatively cheap, small units could be erected economically in isolated localities, and be independent of grid connections.

Besides the search for efficient gas-producing processes, the Gas Council's research includes: utilisation research, that is research into improvements in the usage of gas, especially for industry, modifications to plants and development of new plant and apparatus, chemical research, to establish optimum conditions of operating to produce maximum yields of by-products; and research into heat-transfer techniques, explosion relief and new instruments for gas measurement.

CLUE TO DIAMOND SYNTHESIS

X-RAY studies on diamonds produced in the laboratories of General Electric Co., Schenectady, New York, US, by Professor Kathleen Lonsdale and Dr. H. Judith Grenville-Wells of University College, London, suggest an explanation of the process by which General Electric have prepared synthetic diamonds of industrial quality.

In a preliminary statement (a letter to *Nature*, 1958, **181**, 758) Professor Lonsdale and Dr. Grenville-Wells report that 10 representative specimens selected by them have been studied to date. In every case these laboratory-made diamonds showed one outstanding diffraction feature, namely, the presence of a comparatively strong 200 reflexion, which is never shown by any natural diamond, whether of terrestrial or meteoritic origin. Other 'forbidden' reflexions were also present.

Professor Lonsdale and her co-worker say that the apparent explanation is that each diamond consists of a matrix of normal diamond with the carbon atoms in their usual positions and spacings, but that within this matrix there are islands of a different structure with a lattice constant or spacing close to that of diamond but different from it.

Spectroscopic analysis of the diamonds carried out by Johnson Matthey's research laboratories has demonstrated the presence of some 0.2 per cent of nickel, with smaller quantities of other elements (Si, Al, Fe, Mn, Mg, Na, K, Ti, Ca, Cr, Cu, B). The presence of the nickel 'points to a probable explanation of the subsidiary structure' for nickel does not normally appear as an impurity in natural diamonds. The closeness of its lattice constant to that of diamond indicates that it might be a possible inducer of crystallisation of carbon in the diamond form. The process of cooling from high temperatures and simultaneously expanding it from high pressures could well leave islands of face-centred cubic nickel or Ni_2C or some other nickel compound in a state of strain, it is suggested.

Of interest is the comment that not even the blackest of the laboratory-made diamonds showed any trace of hexagonal or rhombohedral graphites or any other purely graphitic reflection.

Details of the process used by General Electric in preparing these synthetic diamonds are subject to US security regulations. When the company announced in February 1955 that it had succeeded in making diamonds it was mentioned that its scientists had 'gained valuable help from nature,' particularly from studies of diamonds found in Arizona meteorites. This statement will be discussed by Professor Lonsdale and Dr. Grenville-Wells in a future paper. In view of this present report, the paper is awaited with much interest.

NEW COPPER ROASTING METHOD

IN co-operation with CSIRO Division of Industrial Chemistry, Int. Morgan Ltd., Int. Lyell Mining and Railway Co. Ltd., Int. Isa Mines Ltd. and Peko Mines NL., the four major copper producing companies in Australia, have developed a new method of roasting copper concentrates. The method is stated to be particularly suitable for treating sulphate ores on the medium scale of operations required by the Australian companies.

Australian copper is usually combined with sulphur. This sulphur is removed in a 'roasting' process in which the ore is treated in an air stream. The new method involves the 'fluid bed' technique in which a stream of gas is blown upward through powdered solid material. The solid particles are kept in suspension when the speed of the gas is carefully controlled, and behave rather like a violently agitated liquid.

Application of this fluid bed technique to 'roasting' copper ores has necessitated the development of an entirely new design for the base of the roaster. In a base made of refractory concrete are a series of deep tapering holes. At their uppermost ends the holes are large enough to meet in a honeycomb pattern occupying most of the cross-section of the roaster.

It was found that when conventional types of base were tried, lumps formed in the stream of ore particles and clogged the roaster. In this new type of base the lumps are broken down in the fast-moving air stream.

Further work is now being carried out regarding improvements in methods of extracting copper from the roast ore by the electrolytic process.

NEW GAS RESEARCH STATION

Complete Gasification of Low Grade Coals to be Investigated

INVESTIGATION of processes for the complete gasification of low grade coals will be a major part of the work of the Gas Council's Midlands Research Station, Solihull, Warwickshire, opened on 1 April by Sir Cyril Hinshelwood, president of the Royal Society.

This work is part of the Gas Council's research programme which is to develop new processes that will keep the cost of manufacture to a minimum.

For most heating purposes the best and cheapest way of using coal is to gasify it near the mines. Use of low grade coals of high ash content makes the saving even greater. Such coals are becoming more plentiful because of mechanisation of the mines.

It is anticipated that the gas service contemplated for this country will place it in the forefront of those which are dependent on coal.

Gas could be produced in a limited number of super-stations near the mines and transported through a grid system such as exists in the US where natural gas is the chief source of supply.

Five Gasification Processes

The only type of process suitable for coals with high ash content is one in which the coal is completely converted to gas—a carbonisation as opposed to a gasification process. Gasification processes have previously been used on a limited scale only. However, at Solihull five of these processes are being investigated.

(1) *Gasification of coal using Lurgi gasifiers.* This process uses an established German gasifier. It can be supplied with run of mine coal and this can be of up to 30 per cent ash content. The coal is completely gasified at 20 to 30 atmospheres in a mixture of oxygen and steam, the residual ash being withdrawn by a mechanical grate.

This process has been made suitable for installation in this country, first by taking batches of British coal to Germany for test and investigation and, secondly, by investigating methods for enriching the gas to town gas calorific value. Two methods of obtaining gaseous hydrocarbons for enrichment have been developed, viz., by catalytic synthesis from carbon monoxide and hydrogen, and by the hydrogenation of oil. With a Lurgi gasifier in present circumstances, it is cheaper to enrich by the hydrogenation of oil. It is this arrangement which will be used on the pressure gasification plant which is to be installed in Scotland (see CHEM'CAL AGE, 8 March, p. 447).

(2) *Gasification of coal with slagging gasifiers.* The slagging gasifier operates at a very high temperature which requires the ash to be withdrawn molten as a slag. The high temperature results in increased efficiency, high unit outputs, a saving of process steam, a reduction in the cost of by-product recovery. With these advantages it becomes more of a proposition to enrich the gas with methane produced catalytically as an alternative to oil and, with catalytic synthesis, the process becomes an all-coal process.

As indicated, catalytic methane synthesis has been brought to the stage of commercial application, but the slagging gasifier itself is still under test. Installation of a prototype slagging unit on the commercial scale is now being discussed.

(3) *The fluidised coal process.* This process is regarded as offering most promise for application on the largest scale. Processes 1 and 2 both need a proportion of the coal to be above ¼ in. in size. This fluidised process will, however, deal with any size of coal down to dust. It incorporates the hydrogenation of the coal itself, and this is thought to be the best method both for by-product recovery and gas enrichment. The process has reached the pilot scale of development. It will have an overall thermal efficiency of 75 per cent.

(4) *The pressure gasification of oil.* Based on the Gas Council's process of oil hydrogenation this process has two versions, one for distillate oils which can be vaporised and purified before entering the reaction vessel; the other for heavy fuel oils and crude oils which must be atomised into the reaction vessel.

These oil processes differ from those for coal in not requiring oxygen, and this is the principal reason for plant costs being lower. They operate at a thermal efficiency of 80 per cent and are also characterised by high yields of pure benzene as a by-product. A large pilot unit of the version for crude and heavy oil has been recently erected at Solihull while a prototype commercial unit is to be installed at Manchester (see CHEMICAL AGE, 1 March, p. 389).

(5) *The pressure catalytic process for light distillate oils.* This process has been specially developed for peak load purposes. By foregoing the possibility of recovering by-products, the gas-making operation has been reduced to the simplest possible concomitant with producing gas of the highest quality. Operation is at the high thermal efficiency of 85 per cent, while plant units can be of extremely high output, e.g. the output can be 50 million cu. ft. per day from reaction vessels of 10 ft. diameter. If ever oil supplies run short, this process can be supplied with materials such as methanol, which can be synthesised from coal. Commercial installations are now being considered by Area Boards.

The units on which investigation of these processes are being carried out can be seen at Solihull, together with diagrams of the complete processes. In the laboratory at the entrance to the pilot plant building is a unit for the purification of distillates.

This is a laboratory unit in which sulphur is removed from distillate oils by passing them with a gas containing hydrogen over a molybdenum sulphide catalyst at 350 to 380°C. The sulphur compounds are converted to hydrogen sulphide which is absorbed by iron oxide. This method of purification is applied to the distillate oils used in processes 4 and 5. In process 4, besides eliminating gas purification, it enhances the value of by-products, which are obtained sulphur-free. In process No. 5, it prevents the poisoning of the nickel catalyst used for the main gas-making reaction.

In the pressure catalytic gasification of distillate oils process, purified oil vapour

Left: View of the slagging high-pressure gasifier. Right: 1 million cu. ft. a day oil hydrogenation unit

Lurgi high-pressure gasifier control panel

mixed with steam is passed under pressure through a nickel catalyst at 400 to 500°C. A reaction occurs in which the oil is converted to gaseous hydrocarbons. The temperature is then raised to 700°C by adding air prior to a second layer of catalyst and this decomposes a portion of the hydrocarbons to produce town gas. Carbon monoxide is converted as the gas is cooled and, finally, carbon dioxide is removed by washing with hot potassium carbonate.

The slagging gasifier, to be seen in the gasifier bay, which is under investigation as a joint project with the Ministry of Power, is a water-jacketed vessel of 3 ft. internal diameter in which the fuel is gasified under pressure in a mixture of steam and oxygen. This mixture enters through 4 tuyeres round the hearth, reminiscent of blast furnace practice. The ratio of steam and oxygen, which varies from 1.0 to 1.5 by volume, is chosen so that the temperatures developed in the fuel bed are sufficiently high to fuse the ash of the fuel which runs down and collects in the hearth.

The gasifier is being operated to produce 1 million cu. ft. of gas per day, the maximum possible with the steam and oxygen supplies available. There seems little doubt that with increased supplies much higher outputs could be reached. With slagging temperatures, unit outputs of 30 million cu. ft. should be obtainable in commercial plant without difficulty.

Like the slagging gasifier, the Lurgi type gasifies coal under pressure in a mixture of oxygen and steam but temperatures in the fuel bed are kept below the clinkering temperature of the ash by increasing the proportion of steam, viz., to 8–10 volumes per volume of oxygen; the ash can then be extracted by a mechanical grate. An excess of steam escapes decomposition, however, and produces a large amount of liquor. The overall efficiency is reduced in consequence. Nevertheless, the Lurgi gasifier represents an established system of gasification which, under prevailing conditions can be made attractive, e.g., by the addition of a stage of oil hydrogenation for the enrichment of the gas.

The Lurgi type pilot plant on view has an internal diameter of 2 feet and is capable of withstanding pressures of up to 50 atmospheres. It has already been used to make a detailed survey of the reactions and temperatures inside the fuel bed. Tests projected for the immediate future will be concerned with attempts to reduce the consumption of steam.

The pilot scale hydrogenator in the hydrogenation bay is the new 1 million cu. ft. per day unit just completed. It is of the type suitable for crude and heavy oils, the duty of the hydrogenator being to convert these to gaseous hydrocarbons by reaction with hydrogen. The oils are sprayed into the base of a fluidised bed of powdered coke which has the hydrogen streaming through it. The reaction which occurs generates sufficient heat to maintain the temperature at 700 to 800°C. The working pressure is 20 to 30 atmospheres.

Hydrogenation of coal occurs in a pressure vessel 30 ft. high and of 1 foot internal diameter. The coal is first crushed to pass a 35-mesh sieve and is then lock hoppered in at the top. In about 15 minutes it descends to the bed reacting with the hydrogen gas which is passing upwards and maintaining the coal in the fluidised state. As with oil, the reaction produces gaseous hydrocarbons and by-products. The pilot plant is capable of working pressures up to 50 atmospheres.

The various control panels for the hydrogenation and gasification plants are in the gallery. In addition, there is a small plant for the hydrogenation of oil which is used for two purposes. It can be operated as the larger pilot plant with the recycling of the fluidised charge when it is a question of testing samples of crude and heavy oil. Alternatively, it can be used for distillate oils with the production of by-products.

A laboratory is devoted to utilisation research, with the intention of improving the use of gas, particularly in industry. The latest knowledge of heat transfer, fluid flow, and combustion, are applied to the design of industrial gas burners.

Experiments in the chemistry laboratory are designed to fix the conditions of temperature and pressure to be used in the pilot plants, and the first sets of apparatus have been used in particular to establish the conditions necessary, when hydrogenating distillate oils, to produce the maximum yield of valuable by-products—such as benzene and naphthalene.

In the process being developed for the production of gas from oils, the oil is being hydrogenated with hydrogen obtained by reforming part of the gaseous hydrocarbons produced with steam. Reforming is an established process which is used with natural gas and refinery gases, but none of the reformers available match the high performance of the pressure hydrogenator. Development work is in hand to use the advantages of pressure to improve the performance of reformers. It is proposed to use a fluidised bed of nickel catalyst.

Apparatus for the gasification of coal under pressure is used to amplify information obtained from the pilot gasification plants. On the plants themselves, gas samples and temperatures are taken at various points in the fuel bed. These results are then correlated and extended by laboratory measurements under controlled conditions.

All pressure gasification processes depend upon the production of a gas rich in hydrogen but, whether this is produced by interacting steam with coal or hydrocarbons, it initially contains a considerable amount of carbon monoxide. Steps are taken to remove this carbon monoxide, firstly, so that it is not present in the town gas and, secondly, to increase the concentration of hydrogen available for hydrogenation reactions.

When carbon monoxide is converted with steam, it produces hydrogen but also carbon dioxide. The latter has to be removed and a suitable process is to wash it from the gas with hot potassium carbonate solution. This operation is under examination, again so that the optimum performance is obtained when it is used as one stage in a pressure gasification process.

'Hazel' Reactor in Operation

'HAZEL', a new zero-energy reactor, is now operating at the Atomic Energy Research Establishment at Harwell.

Hazel (homogenous assembly—zero energy) uses enriched uranium fuel in the form of a salt of uranium curanyl fluoride which is dissolved in the heavy water used as a moderator. The core of the reactor is a stainless steel cylinder seven feet high by two feet diameter surrounded by a graphite reflector. The fuel solution is pumped into the cylinder from two nearby storage vessels. The system is controlled by adjusting the level of the fuel solution in the reactor vessel and by moving a vertical neutron-absorbing cadmium plate into the gap between the steel cylinder and the graphite reflector. Two cadmium plates similar to the control device, are used as 'shut-off' rods: two additional 'shut-off' rods can be dropped vertically into the fuel solution in the reactor vessel. The reactor will be operated at a power of less than a watt and cooling is not necessary.

Isotope Course at Harwell

A course on radioisotopes designed to give senior executives in industry an appreciation of the possible applications of those materials will be held at the Harwell Isotope School from 23 to 26 September.

DR. CRAIK REVIEWS ICI NOBEL DIVISION'S NEW PROJECTS

1957 Sales Increase Satisfactory

'SALES of explosives and accessories in the home market during 1957 showed a satisfactory improvement compared with the previous year and so far this year, the level of sales is being maintained'. Imperial Chemical Industry's Nobel division chairman, Dr. James Craik, gave this summary of the position of the division on 26 March at the spring meeting of the division council, staff and foremen's committee.

Increasing demands have been made on the division's established and newer products, said Dr. Craik, by the development of new and larger opencast coal sites. Also, despite keen competition from both home and continental producers there had been a general improvement in the sales of the division's principal chemical products last year. New uses and outlets for these products were, however, being developed with reassuring prospects for the future. In export markets sales of high explosives during 1957 were only slightly lower than the very high level attained during 1956. The 1956 figure would have been exceeded in spite of the loss of the Egyptian market and the effect of local production in Peru if there had not been a financial crisis in India. The demand for explosives used in seismic prospecting had continued to increase all over the world, and a substantial new market had been established in North Africa, reported Dr. Craik. Record sales had also been achieved in delay detonators.

New Sales Records

With the exception of potassium and barium nitrate, sales of all chemical products produced by the division increased during the year. New records were achieved for industrial nitrocellulose, Cellofas, Edifas and calcium formate. Sales of pentaerythritol were the second highest on record.

Judged by the position today, stated Dr. Craik, the prospects for 1958 were encouraging and the demands for all the division's products continue at approximately last year's level. Of the effects of future production from the factory in India, he said that the replacement of lost business could only be obtained by meeting the very keen competition now being offered in an increasing number of world markets. Dr. Craik stressed particularly the urgent need for every possible economy in production costs.

Dr. Craik also reviewed the division's recent projects. He reported that the first Biazzi unit had continued to perform very satisfactorily, using all the remote control equipment, including television. An almost exactly similar unit had been installed at No. 2 Hill and was satisfactorily commissioned early last month. It was now producing at its designed output, reported Dr. Craik. This plant is under manual control but work is proceeding with the installation of the remote control equipment which will be largely similar to that at No. 5 Hill. However, instead of television equipment, a high-grade optical system on the periscope principle is being employed. It is reported to give an excellent picture in natural colour in the control room.

The last batch hill at Ardeer is to be replaced by a new plant which will be continuous in operation and of different design.

Extensions to the No. 1 mechanised nitroglycerine units at Misk were virtually complete and ready for production, stated Dr. Craik. Trials with dummy material had been carried out. The prototype unit for making nitroglycerine explosives under remote control are reported to be in an advanced state of construction. The latest developments in the technology of handling and mixing ingredients used for making explosives are embodied in this plant.

'The complex but very successful unit at Ardeer' for the mechanised production of plain detonators had, during the last few months, continued with its production trials 'in a most satisfactory way', Dr. Craik said. The plant was an outstanding example of the application of modern technology to problems of reducing hazards in manufacture.

Cellofas plant extensions at Dumfries have been completed and the pentaerythritol plant is producing at a high rate. At Ardeer work has been started for a large-scale isopropyl nitrate plant. The foundations were being laid. Extensions to the Ardeer silicones plant have been completed and the plant is now in full production. The new plant for concentrating nitric acid by the magnesium nitrate process is reported by Dr. Craik to have performed extremely well and is operating at its designed output.

Dr. Craik also announced that expenditure has been authorised by the main board of ICI for a new plant at Ardeer which will manufacture nitric acid. This plant will have certain special features. Heat and energy from the process will be fully recovered by means of a waste heat boiler and a steam turbine, which together with a gas turbine will drive the main air compressor.

New Low Cost Nickel Coating Said To Be Tougher Than Steel

LOWERED costs of chemical processing equipment are promised by a new nickel coating development announced by Metachemical Processes Ltd., of Crawley, Surrey on Monday this week. Known as micrograin (mikrograne) nickel, this sheeted nickel is so fine grained that it cannot be etched properly for metallographic studies. It is claimed to resist abrasion and impact better and is said to be much harder than other types of the formed or electro-deposited metal. Brinnell hardness is 600. It is, however, very flexible and deposited sheets can bend without cracking.

Conventional depositing of nickel produces a grain size comparable to that of the base metal, since the electric flux is homogenous except at grain boundaries of the substrate. Somewhat finer grains can be deposited using organic addition agents. The new Metachemical process puts a thin flexible sheet of milled graphite, held together with a resin binder, between base and coating. The layer contains 85 per cent graphite which is reduced to particles of about one micron. These conductive particles are stated to be much finer than grains on a metal base and after being given a thin copper flash, produce a correspondingly fine size in the deposited layer. It is this microscopic structure of the deposit which is responsible for the excellent properties of this nickel coating. Mr. H. Denis Hughes (managing director) and Mr. R. W. Lewis (research director) discoverers of the process, believe that the nickel deposited is a different type of nickel in that the finished electroform is under compressive stress, whereas most electrolytic nickel deposits show tensile stress. Indeed, Mr. Hughes reports that the compressive stresses set up are so noticeable that care must be taken to prevent cutting of the masking tape at the trailing edge, which would allow solution to enter between the mandrel and the plastic interlining.

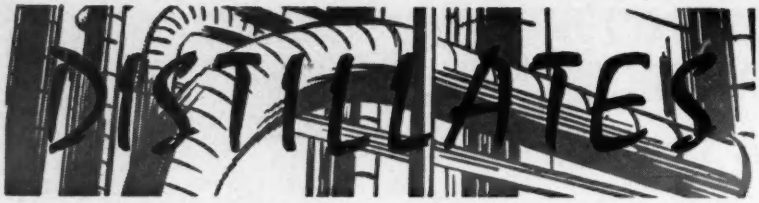
The graphite-filled sheet facilitates removal of the electroform from its mandrel and is washed from the finished form by organic solvents. The cleaned nickel sheet is then bonded to its base with epoxy resins. Conventional-type electrochemical baths which normally produce soft nickel coatings can produce the new micrograin structure.

Results with nickel show that grain size can be so restricted that from the same electrolyte, under the same conditions, nickel with a hardness controllable between 120 and 800 Vickers pyramid number can be obtained.

Electroforms can be made of the material in almost any conceivable shape and are claimed to exhibit strength superior to similar construction from stainless steel or other comparable material.

Applications for micrograin nickel would be in the chemical and food-processing industries where stainless or glass-lined vessels, reactors and mixers have been required. Thin nickel liners can be cemented over strong steel base-metal with considerable saving in costs. The liners are stated to wear better than those of stainless steel, can be removed and replaced quickly, economically and with relative ease.

Facilities to produce micrograin metal products are being installed at Dalic Metachemical Ltd., Toronto, Canada, Metachemical Processes report. Plans also include a plant in north-eastern US.



A HINT of a large capital development programme by a company that has already expanded fast in the last few years is given by Mr. R. C. Fenton, chairman and managing director of Pfizer Ltd., in the recently published first issue of *Pfizerama*, the company's new house magazine. In stating that a 'new major phase of development is rapidly taking shape at Sandwich', Mr. Fenton adds that capital projects now being undertaken are substantially larger than the total of the original investments at Folkestone and Sandwich.

1958 beckons Pfizer Ltd. into 'new, exciting and challenging fields—about which future issues of *Pfizerama* will have much to say'. Among other things, important new research departments have started work. An article on the firm's history says that very soon a building to house various production control laboratories and offices will be completed as will a new plant for producing steroids and other synthetic organics. A new biological production unit is nearing completion in record time, while dies are cast for further experimental production and research units and a new administrative block.

This attractive new magazine features the story of Terramycin in strip cartoon form. I learn that it was the work of the company's own art department.

★

THE Hull trawler owners have sought Government sanction to add the antibiotic aureomycin 'Acronize' to the ice in which fish is preserved. In their application it was stated that such addition could prolong the freshness of fish for at least an extra 60 hours.

The use of Acronize is permitted for this purpose in Canada and several other countries allow it to be used in the preservation of food. In the annual report of the Hull City Laboratories for 1956, Mr. D. J. T. Bagnall, public analyst and corporation bacteriologist, states that the addition of 3 to 5 p.p.m. of antibiotic to sausages extends their fresh life by 50 to 100 per cent, at the same time maintaining their fresh colour.

★

RECENT news of the extension of the ICI fellowship scheme, which is now to cost the company about £93,000 a year (see CHEMICAL AGE, 25 January, page 198) may have conjured up in some minds the vision of more and more scientists grinding out research purely for the benefit of ICI.

I am glad to say that in fact these fellowships carry no strings whatever. Worth between £700 and £1,000 a year, they are designed to give outstanding scientists the opportunity of carrying out post-doctorate research at universities in the fields of chemistry, physics, engineering, pharmacology and applied sciences. The appointments are made by the universities and ICI exercise no control over the matter or manner of research.

If ICI do not benefit then who does? A good example is the case of Dr. Peter Thonemann, leader of the AERE Zeta group at Harwell, which has led the world in the development of apparatus capable of producing a thermonuclear reaction. Dr. Thonemann was an ICI fellow and used his grant to study gas discharge phenomena and their applications in nuclear science at the Clarendon Laboratory, Oxford.

★

SOME interesting statistics on the amounts of fertiliser that farmers apply to different crops are contained in a survey made by A. C. Nielson Co. Ltd., Oxford, on behalf of Fisons. Based on a random sample of more than 2,000 representative farms, not necessarily users of Fisons' fertilisers, the survey shows that 81 per cent of farmers growing winter wheat applied inorganic fertiliser to some part of their acreage in 1957. The figure for spring wheat was 77 per cent.

Most of the fertiliser used at wheat sowing is in compound form, particularly for spring wheat. Last year 54 per cent of the winter wheat and 75 per cent of spring wheat received a basic dressing of compound material. In 1956 only 57 per cent of the winter wheat acreage was top-dressed, with a rise to 62 per cent in 1957.

Rates of nitrogen application are shown to have fallen, the 1957 amounts being 46 lb. for winter wheat and 39 lb. for spring wheat.

★

COMMENT that Wales may have lost a new chemical industry because of fears of nationalisation under a Labour Government has led to controversy in the principality. Sir David Eccles, President of the Board of Trade, in a party broadcast on TV last week said that a foreign chemical firm had inquired where they should build a factory to employ several hundreds of workers. They liked the idea of Wales and asked Sir David if he could guarantee that the chemical industry would not be nationalised.

Sir David added: 'What could I say? I could not give them any guarantee.' No further information is available but three possibilities have been put forward. First, the negotiations that have been going on with Ashburton Chemicals for a new plant at Glynllyfon (this is hardly a foreign firm, except in the sense that it is not Welsh!); second, a project that has been linked with Llanelly; and third, the possibility of petrochemical plants in association with the Milford Haven refinery project.

Mr. G. Roberts, Labour MP for Caernarvon, has pointed out that nationalisation of the chemical industry is not in his party's programme. He added that the firm interested in the Glynllyfon site had applied for an industrial certificate. The requisite water order had been prepared by the local authority and should be finalised quite soon.

Several questions were due to be asked in Parliament this week, shortly after this issue had gone to press, earlier than usual. They will be reported next week.

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VISION of a mass unemployment among white-collar workers was the theme of a talk given by Dr. W. H. Garrett, director of Monsanto Chemicals and new president of the British Employers' Confederation at a Wrexham Rotary Club dinner last week. Dr. Garrett believes that within 10 years electronic brains will have ousted the white-collar worker in industry, the civil service and big business organisations.

He said that the electronic computer would soon make routine clerical work a thing of the past, except in small firms which could not afford the capital outlay involved. These somewhat frightening devices can do the work of a thousand clerks more efficiently in a fraction of the time. They never suffer the human failing of getting tired, they work a day and night shift, need no paid holidays or tea breaks. They never get married and leave.

Dr. Garrett knows something of the subject for as I reported a few months ago Monsanto have installed an electronic brain at their London head office. Most of the large chemical companies also use these computers; as yet they also employ large clerical staffs.

★

THAT spectacular savings in fuel consumption have been achieved by firms that use the National Industrial Fuel Efficiency Service is now well known. I was particularly interested in details sent to me by NIFES of alterations made last May to an oil-fired rotary fertiliser drier at the plant of Robert Stephenson and Son Ltd., Beverley, Yorks, that cut fuel consumption by half.

As a result, the combustion chamber was redesigned and ducting installed to recirculate gases from the kiln exit fan to the inlet. Before making those adjustments, fuel oil consumption was 6.25 gal. per ton of product. This was reduced to 4.4 gal. and at the end of last year a second NIFES survey was made which showed that by insulating the ducts and using preheated air, consumption could be further cut to 3.8 gal. per ton of product.

An interesting feature of this work is that Robert Stephenson say that greater fuel efficiency has brought them an unexpected bonus in the form of a better quality product.

Alembic

RECENT RESEARCH ON NON-AQUEOUS TITRATIONS

Paper at Midlands SAC Meeting

MOST WORK on non-aqueous titrations has been done in the last seven years. This was stated in a discussion on 'Non-aqueous titrations' opened by Mr. E. H. Tinley (Chelsea Polytechnic) at a recent meeting of the Midlands Section of the Society for Analytical Chemistry held in the Gas Showrooms, Nottingham.

Non-aqueous titration was first used as an analytical procedure in 1910 when Folin and Wentworth (1) titrated certain higher fatty acids with sodium alcoholate using chloroform, carbon tetrachloride and toluene as solvents and phenolphthalein as indicator. Subsequent progress in this field was slow, probably due to the fact that the most widely accepted theory of acids and bases was that of Arrhenius which applied to aqueous solutions only. Moreover, since electrolytic dissociation into ions was considered to be a necessary preliminary step in all neutralisation reactions, the possibility of performing neutralisation reactions in non-ionising solvents, such as benzene, would tend to be overlooked.

The Lowry-Bronsted Theory, published in 1923, could be applied satisfactorily to many acid-base reactions in non-aqueous solution. Undoubtedly it paved the way for all recent developments in non-aqueous titrimetry.

In 1935, Nadeau and Branchen (2) published a method for determination of amino acids which gained wide acceptance, but most work on non-aqueous titration had been done within the last seven years.

Lowry and Bronsted defined an acid as a substance which dissociated to give a proton, and a base as a substance which combined together with protons. An acid HB dissociated to give a proton together with the conjugate base B^- of the acid:

$$\underset{\text{Acid}}{HB} \rightleftarrows \underset{\text{Proton}}{H^+} + \underset{\text{Base}}{B^-} \quad \text{.....(I)}$$

In the reverse reaction, the base B^- reacted with a proton to give the conjugate acid HB of the base.

Types of acid and base were as follows:

	Acids	
Electrically neutral molecule	HCl	$\rightleftarrows$
Positively charged cation	$C_6H_5NH_3^+$	$\rightleftarrows$
Negatively charged anion	HSO_4^-	$\rightleftarrows$

Bases	
$H^+ + Cl^-$	Negatively charged anion
$H^+ + C_6H_5NH_2$	Electrically neutral molecule
$H^+ + SO_4^{--}$	Negatively charged anion

A substance which was potentially acidic did not function as an acid until it was brought into contact with a base and vice versa. Non-aqueous solvents might be protophilic, protogenic or aprotic in type. Some exhibited both protophilic and protogenic properties; these were called amphiprotic solvents.

Aprotic solvents were neutral substances, such as benzene and chloroform. They were relatively non-reactive and did not favour ionisation, but could still be used as vehicles for neutralisation reactions. They were often added to solvents which favoured ionisation in order to depress solvolysis (comparable with hydrolysis) and so sharpen the end-point. Their low dielectric constants were disadvantageous in potentiometric titrations but their use in such determinations was not altogether precluded.

Protophilic solvents, such as ethers (including dioxan) and amines, were basic substances. They would react with an acidic solute to form a solvated proton together with the conjugate base of the acid:

$$\underset{\text{Acid}}{HB} + \underset{\text{Basic solvent}}{S} \rightleftarrows \underset{\text{Solvated proton}}{SH^+} + \underset{\text{Conjugate base of acid}}{B^-} \quad \text{.....(II)}$$

If B^- was a weak base, then HB would be an intrinsically strong acid and vice versa.

Reference to equation (II) indicated that the position of the equilibrium would depend upon the intrinsic strengths of the acid HB and the basic solvent S. Effect of mixing acids and bases of differing strengths was as follows:

Acid, HB	*Base, S*	*Character of solution*
Strong	Weak	Strongly acidic
Weak	Weak	Weakly acidic
Strong / Weak	Strong	Acids tended to assume approximately equal strengths (the levelling effect)

Very weak acids, such as phenols, failed to give sharp end-points under aqueous conditions but could be titrated to a visual end-point in the more strongly basic ethylenediamine in which their acidic strengths were enhanced by the levelling effect.

Protogenic solvents, such as sulphuric acid, were acidic substances. They exerted a levelling effect on bases. Amphiprotic solvents exhibited both protogenic and protophilic properties. They were liquids which ionised to a slight extent. Water, acetic acid and alcohols were examples.

When water dissociated to form hydrogen and hydroxyl ions, it functioned as an acid:

$$H_2O \rightleftarrows H^+ + OH^- \quad \text{.....(III)}$$

Cf, equation (I)

In subsequent interaction of the hydrogen ions with undissociated water molecules to form hydroxonium ions, water functioned as a base:

$$H_2O + H^+ + OH^- \rightleftarrows H_3O^+ + OH^- \quad \text{.....(IV)}$$

Acetic acid behaved similarly:

$$CH_3COOH \rightleftarrows H^+ + CH_3COO^- \quad \text{(acidic properties)}$$

$$CH_3COOH + CH_3COO^- + H^+ \rightleftarrows CH_3COOH_2^+ + CH_3COO^- \quad \text{(basic properties)}$$

If an intrinsically strong acid, such as perchloric acid, was dissolved in acetic acid, acetic acid functioned as a base and the proportion of $CH_3COOH_2^+$ ions in solution was increased. Since the CH_3COOH_2 ion could very readily donate a proton to a base, the solution functioned as a strong acid.

However, acetic acid also had acidic properties and so would exert a levelling effect with the result that basic properties of weak bases became enhanced. Thus, many bases which were too weak to give satisfactory end-points in aqueous solution could be titrated successfully under non-aqueous conditions. The equations representing reaction between pyridine and perchloric acid in acetic acid were:

$$HClO_4 + CH_3COOH \rightleftarrows CH_3COOH_2^+ + ClO_4^-$$

$$C_5H_5N + CH_3COOH \rightleftarrows C_5H_5NH^+ + CH_3COO^-$$

$$CH_3COOH_2^+ + CH_3COO^- \rightleftarrows 2CH_3COOH$$

After his general introduction, Mr. Tinley dealt, in some detail, with non-aqueous titration of bases. No special apparatus or precautions were needed, but if acetic acid was heated to facilitate preparation of a solution, the flask should be fitted with a silica gel drying tube during cooling.

Glacial acetic acid was used in preparation of acetous perchloric acid and also as a solvent for the base to be titrated. Up to 1 per cent of moisture could be tolerated, but greater amounts led to flat end-points (3). Sharpest end-points were obtained with a water content of 0.01-0.1 per cent, surplus water being removed by addition of acetic anhydride. After allowing 24 hours for completion of the reaction, the water content should be checked by the Karl Fischer technique to ensure compliance with the above limits. Excess of acetic anhydride was not always disadvantageous but primary and secondary amines gave erroneous results due to the ease with which they acetylated.

Dioxan, which had been purified by shaking with Amberlite IRC-50 and filtering, was used in preparation of standard solutions of perchloric acid (4). These were recommended for titration of amine salts (5) and for use in conjunction with phenol-chloroform-acetonitrile solvent (6).

Titrants for bases included acetous perchloric acid, prepared by mixing 72 per cent perchloric acid with glacial acetic acid and adding sufficient acetic anhydride to react with surplus water. The perchloric acid should be well diluted with acetic acid before adding acetic anhydride to avoid formation of explosive acetyl perchlorate. Another titrant, perchloric acid in dioxan, was prepared by adding

72 per cent perchloric acid to purified dioxan. Use of unpurified dioxan produced a solution which darkened rapidly on storage. Potassium hydrogen phthalate (7) was a suitable standard for the above titrants.

A glass electrode together with a 'sleeve' type calomel electrode could be used in potentiometric titration of bases. In acetic acid, the glass electrode usually assumed a positive potential with respect to the calomel electrode (reverse of what happened in water). Accordingly, an auxiliary source of e.m.f. had to be connected in such a way as to 'back off' a proportion of the electrode e.m.f. unless the pH meter had provision for reversing the galvanometer leads. Care had to be taken to prevent leakage of contents of the calomel electrode into the titration liquid as these reacted with acetous perchloric acid. Titration curves could be drawn by plotting volume of titrant against uncorrected meter readings.

Visual indicators included crystal violet (7) (colour change from violet, through blue-blue green, to green-purple), oracet blue-B (8) (colour change from blue, through blue-purple, to pink) and quinaldine red (9) (colour change from red to red-colourless).

Primary, secondary and tertiary amines (10) could be dissolved in acetic acid and titrated with either acetous perchloric acid or perchloric acid in dioxan to either a visual or a potentiometric end-point. Alkaloids (11-14) and many medicinal sulphonamides came into this category. Purines (15-17) could be treated similarly but it was advisable to add an aprotic solvent, such as carbon tetrachloride or benzene, to sharpen visual end-points.

Amino acids (2) were dissolved in excess of acetous perchloric acid and back titrated with acetous sodium acetate. This procedure overcame the slight solubility of many amino acids in acetic acid; their perchlorates were much more soluble. Alternatively, amino acids could be dissolved in the minimum amount of formic acid and titrated directly after dilution of the solution with acetic acid (18, 19). This procedure avoided errors due to the tendency of amino acids to acetylate when boiled with acetous perchloric acid in order to effect solution.

Picrates of amines yielded picrate ions in acetic acid solution (20). The picrate ion was a sufficiently strong base to give a good visual end-point. Preparation and titration of a picrate provided an easy method for determination of the equivalent weight of an amine. Other organic acid salts could be determined similarly.

Since halide ions were very weak bases, they did not react quantitatively with acetous perchloric acid. Addition of mercuric acetate (5) (between two and three times theoretical quantity) to the hydrohalide of an amine resulted in liberation of an equivalent amount of acetate ion which was a strong base in the acetic acid system:

$$2RNH_2HCl \rightleftarrows 2RNH_3^+ + 2Cl^-$$

$$(CH_3COO)_2Hg + 2Cl^- \rightleftarrows \underset{\text{undissociated}}{HgCl_2} + 2CH_3COO^-$$

Quaternary ammonium halides (5) could be determined similarly. The mercuric acetate itself must have no appreciable titration value.

Many metallic salts of organic acids dissociated into their constituent ions in solution in acetic acid (3, 21). As the anions reacted readily with protons under these conditions, the salts from which they were derived could be titrated as bases in acetic acid solution:

$$RCOOM \rightleftarrows RCOO^- + M^+$$

$$CH_3COOH_2^+ + RCOO^- \rightleftarrows CH_3COOH + RCOOH$$

Use of potassium hydrogen phthalate in standardisation of non-aqueous solutions of perchloric acid depended upon reactions of this type.

Following his account of non-aqueous titration of bases, Mr. Tinley dealt with titration of acids in non-aqueous media. Solvents used as vehicles in titration of acidic substances very rapidly absorbed atmospheric carbon dioxide and steps had to be taken to avoid errors from this source.

Standard solutions of methoxides of alkali metals, non-aqueous titrants for acids, were prepared by dissolving the metals in a mixture of benzene and methanol. Both solvents needed to be redistilled from sodium to prevent discolouration of the product on storage. The proportion of methanol was kept to a minimum required to produce a clear solution. Use of dry benzene reduced the amount of methanol necessary to achieve this.

Sodium and potassium methoxides tended to give gelatinous precipitates during titrations. This was less frequent with lithium methoxide, but potassium methoxide had been stated to be the strongest base. It also needed less methanol to produce a clear solution than the sodium and lithium compounds.

Tetrabutyl ammonium hydroxide (22), prepared by shaking a solution of tetrabutyl ammonium iodide in absolute methanol with silver oxide, filtering and diluting to volume with dry benzene, was also used for titration of acids. The solution was flushed with carbon dioxide-free nitrogen and protected from carbon dioxide and moisture during storage.

The above titrants were standardised against benzoic acid dissolved in dimethylformamide using thymol blue as indicator.

A glass-calomel system could be used for potentiometric titration of acids if the solvent was acetonitrile (23). In more basic solvents, a pair of antimony electrodes, one dipping into the titrant and the other into the solution being titrated, could be used (24). Other systems consisted of a glass electrode with either a platinum or an antimony electrode, the glass electrode appearing to act as reference rather than as indicator electrode (25).

The above system could not be used, however, in the more basic solvents if the titrant contained sodium, but if the tetrabutyl ammonium hydroxide was the titrant, the glass-calomel system functioned in both dimethylformamide and ethylenediamine (22).

Carboxylic acids, barbiturates (26-28) and sulphonamides of the type $RHNSO_2R^1$ could be dissolved in dimethylformamide and titrated with either of the titrants mentioned above. Thymol blue (colour change from yellow to blue) and quinaldine red (colour change from magenta to pale greenish yellow) were suitable visual indicators. Acidic impurities in the dimethylformamide had to be neutralised immediately before use of the solvent. This applied to all basic solvents.

Very weakly acidic substances, such as phenols (5), required a strongly basic solvent, such as ethylenediamine. A suitable indicator for phenols was *o*-nitroaniline (colour change from clear yellow to orange red).

Acidic properties of certain salts (29), such as pyridine picrate, ammonium sulphate and quinine sulphate, were enhanced by solution in a basic solvent. Dimethylformamide was a suitable solvent in many cases. Salts which were insoluble in dimethylformamide were dissolved in a small quantity of water and mixed with a large excess of ethylenediamine. Azo-violet (colour change from red to blue) was a suitable indicator. Weakly acidic substances (28, 30, 31) and certain enols could also be titrated in ethylenediamine using azo-violet as indicator.

In conclusion, Mr. Tinley mentioned some miscellaneous examples of non-aqueous titrimetry. A suitable solvent for potentiometric differentiating titration of bases (23, 32, 33) needed to have neither pronounced acidic properties (which would exert a levelling effect on the bases) nor pronounced basic properties (which would interfere with titration of weak bases). Acetonitrile and chloroform had been found to be suitable.

REFERENCES

(1) Folin and Wentworth, *J. Biol. Chem.*, 1909-10, **7**, 421.
(2) Nadeau and Branchen, *J. Amer. Chem. Soc.*, 1935, **57**, 1336.
(3) Beckett, Camp and Martin, *J. Pharm. Pharmacol.*, 1952, **4**, 399.
(4) Levi, Chatten and Pernarowski, *J. Amer. Pharm. Assoc.*, Sci. Ed., 1955, **44**, 61.
(5) Pifer and Wollish, *Analyt. Chem.*, 1952, **24**, 300.
(6) Chatten, *J. Pharm. Pharmacol.*, 1955, **27**, 586.
(7) Seaman and Allen, *Analyt. Chem.*, 1951, **23**, 592.
(8) Beckett and Tinley, *Titration in Non-aqueous Solvents*, The British Drug Houses Ltd.
(9) Higuchi, Feldman and Rehm, *Analyt. Chem.*, 1956, **28**, 1120.
(10) Wagner, Brown and Peters, *J. Amer. Chem. Soc.*, 1947, **69**, 2609.
(11) Gautier and Pellerin, *Ann. Pharm. franc.*, 1952, **10**, 401.
(12) Herd, *J. Amer. Pharm. Assoc.*, Sci. Ed., 1942, **31**, 9.
(13) Levi, Ostreicher and Farmilo, *Bull. Narcotics, U.N.*, 1953, **5**, 15.
(14) Snengler and Kaelin, *Pharm. Acta Helv.*, 1943, **18**, 542.
(15) Dimroth and Meyer-Brunot, *Biochem. Z.*, 1952, **323**, 338.
(16) Poulos, *Analyt. Chem.*, 1952, **24**, 1858.
(17) Pernarowski, *Drug Standards*, 1953, **21**, 189.
(18) Ekeblad, *Svensk farm. Tidskr.*, 1953, **57**, 185.
(19) Toennies and Callan, *J. Biol. Chem.*, 1938, **125**, 259.
(20) Auerbach, *Drug Standards*, 1951, **19**, 127.
(21) Markunas and Riddick, *Analyt. Chem.*, 1951, **23**, 337.
(22) Cundiff and Markunas, *ibid*, 1956, **28**, 792.
(23) Fritz and Keen, *ibid*, 1953, **25**, 179.
(24) Katz and Glenn, *ibid*, 1952, **24**, 1157.
(25) Fritz and Lisicki, *ibid*, 1951, **23**, 589.
(26) Ryan, Yanowski and Pifer, *J. Amer. Pharm. Assoc.*, Sci. Ed., 1954, **43**, 656.
(27) Heiz, *Dansk Tidskr. farm.*, 1952, **26**, 69.
(28) Vespe and Fritz, *J. Amer. Pharm. Assoc.*, Sci. Ed., 1952, **41**, 197.
(29) Fritz, *Analyt. Chem.*, 1952, **24**, 306.
(30) Fritz and Keen, *ibid*, 1952, **24**, 308.
(31) Faber, *J. Pharm. Pharmacol.*, 1954, **6**, 187.
(32) Fritz, *Analyt. Chem.*, 1953, **25**, 407.
(33) Pifer, Wollish and Schmall, *ibid*, 1954, **26**, 215.

ABCM PACKAGING CONFERENCE

Open Forum and Discussion Groups Reported

IS it right to add a single penny to the package cost for any purpose unless essential? That question, announced as being anonymous, was the first put to the open forum held on 18 March. The panel comprised A. F. Much (ICI, Manchester), chairman, Dr. G. L. Riddell (A. E. Reed Ltd.), A. F. Cowan (Metal Box Co.), C. C. Hazelwood (Metal Containers Ltd.), R. H. Birtles (ICI), B. E. Moody (United Glass Bottle Manufacturers Ltd.).

This forum took place during the packaging conference held by the Association of British Chemical Manufacturers at Buxton from 18 to 20 March. The papers presented at the conference and the ensuing discussions were reported in our last week's issue, p. 587; this week we report the forum and the three discussion groups on metal drums; plastics containers; and jute and paper sacks.

Mr. Birtles said there could be technical reasons which would give better service for the extra penny.

Dr. Riddell felt there was every justification for spending that penny purely on decorating the package.

Mr. Moody disagreed, declaring that 'anything done to make a package more expensive is a bad thing'.

In reply to *Mr. George Brearley* (ABCM director), who wanted to know what literature the manufacturer should seek in order to deal with packaging in a free trade area, it was stated that there were at least 17 publications dealing with regulations for the various countries. *Mr. G. H. Edwards* (Unilever Ltd.) said that to cope with that number of regulations, a firm must accept the fact that it would need a full-time packaging expert.

The question arose as to whether the ABCM should consider setting up a bulk distribution system on the Continent. *Mr. C. D. Callieu* (Shell Chemical Co.) thought this was an important point and that bulk storage depots on the Continent would help economic distribution of chemicals.

Mr. T. H. Craig (Shell Petroleum Co. Ltd.) said that the problem needed more than an individual approach by one company to bring the best benefits. For their world-wide depot system, Shell received good prices for pallet handling. But the cost of repairing these pallets was prohibitive, most of the damage taking place in stevedoring.

Dr. Riddell told *Mr. A. Roche* (Monsanto Chemicals) of a US development to replace the fluting of corrugated board with a foam polystyrene. That could be done, again at a price, but as yet had not been taken up in the UK.

Panel at the open forum, l. to r., C. C. Hazelwood, Dr. G. L. Riddell, A. F. Much, chairman, A. F. Cowan, B. E. Moody and R. H. Birtles

Mr. J. M. Butler (Lewis Berger and Co. Ltd.) asked if delegates appreciated that packaging represented an important side of the chemical industry. He thought it important that they should study what the packaging manufacturers had to offer.

An anonymous questioner wanted to know if it was feasible to produce a comprehensive list of all chemicals that were packaged. This would help a firm wishing to market a new product but which did not want to broadcast what they were doing. It was thought that the use of such a list would be dangerous, because the packaging of each chemical raised problems that called for individual treatment and consideration. There were questions of destination, bulk, toxicity, compatibility, etc., which varied from case to case.

Mr. J. Griffith (Clayton Aniline Co.) wanted to know why makers of open-top drums could not make their lids to a standard size so that they were fully interchangeable. Mr. Hazelwood, pointing to the retooling difficulties involved, said that this was a big problem for the smaller firm. The drum industry had made a start in standardisation, and although it was a slow process, lids would become interchangeable as more firms retooled on a standard basis.

Mr. W. L. Guest (ICI Billingham) thought the move to bulk transport inevitable. If a manufacturer could substantially reduce his price by eliminating the packages then he would do away with packages. That was happening on the Continent, particularly in Germany.

In a discussion on standardisation, Mr. Moody referred to the BS for 80- and 90 oz. Winchesters introduced five years ago, but the 80-oz. size in BS form had not been made as there was no demand for it.

Development of intermediate bulk containers was raised by *Mr. J. W. Crewe* (Monsanto Chemicals). It was felt that an existing commercial system of 1-ton storage bins tended to be expensive. It was pointed out that Shell had recently introduced a scheme for a 1-ton expendable container for chemicals based on hardboard panels and a wooden framework. The pallet had a second-hand value. Excluding the pallet the price worked out at £1 11s more per ton than the bagged price. The saving in freight represented £1 5s per ton. A further £1 per ton could be saved if the pallet battens could be reduced in size.

Need for Coated Non-Returnable Drum

THE widespread need in the chemical industry for a relatively cheap non-returnable drum coated to resist attack by corrosive liquids was discussed by the metal drums discussion group, under the chairmanship of Mr. L. W. Stubbs (Albright and Wilson). It was felt that this need should be brought to the attention of the drum makers.

The possibility of reducing the gauge of steel to cut the cost and to increase the strength of the corrugations was also raised, but the practice was not recommended. The use of loose plastics liners in drums was thought to be a temporary expedient, as compared with painting the interior. It was thought that an Epikote resin would last longer for storage but that firms which repainted their drums for each journey would prefer to use a paint that could more easily be removed.

There was considerable support for the square section drum in favour of the conventional type. On the question of standard closures, drum makers present felt that it would not be possible to standardise. That was essentially a matter for individual designers in each company. It might be helpful, however, if the top of the drum and the lid dimension could be standardised.

In a discussion on the 4 per cent minimum ullage, it was decided that for normal products there was no call to ask the Ministry of Transport to revise the regulations. It was thought, however, that liquids with a high rate of pressure might call for a different technique and possibly a different package.

DEVELOPMENTS IN PLASTICS FOR PACKAGING MATERIALS

A NUMBER of possible new developments was discussed by the plastics group under the chairmanship of Mr. R. H. Birtles (ICI). For the small retail plastics pack, the group considered the possibilities of using laminates to reduce permeability to water, gas, and odour. Saran-coated kraft, saran-coated collapsible tube, polythene-coated Cellophane, saran-coated Cellophane and saran-coated Mylar were some of the laminates mentioned.

For sterilisable pharmaceutical packs, polypropylene, nylon and polyethylene-terephthalate were thought to be materials of the future. Work on polythene-coated Melinex was being carried out in the UK, but there was a need to improve adhesion before anything was placed on the market; it was stated that a product should be available before long.

As far as a polyethylene-terephthalate laminate for drum liners was concerned, Mr. Birtles said that it was available in film form although it had not been pushed for use in packaging. The film was extremely strong, but contained a high static charge. The main problem was in heat sealing for the seal was not as strong as the parent material. One answer was to coat the material with a film of heat-soluble lacquer. Du Pont had carried out experiments with Mylar in this respect.

As the tensile strength of polyethylene-terephthalate was 25,000 lb. p.s.i., a liner could be made from a very thin film, thus keeping down the cost. The material was very transparent and had extremely low gas permeability properties. This suggested a use in the retail packaging field.

Film Liners

Discussing film liners for drums or fibreboard kegs, the general feeling was that this was satisfactory for transporting solids and powders, but that it was not at present satisfactory for the export of liquids. There was a need for a 10- or 40-gall. expendable container to hold corrosive acids. It was pointed out that a light duty inexpensive drum with a 40,000th-in.-thick polythene lining (the Polidrum) had recently been marketed in 5-, 10- and 12-gall. sizes. A 45-gall. version was under consideration. That development, it was stated, was getting near the price the chemical firm could afford for packing a corrosive product for export.

Dealing with the use of thermosetting plastics as coatings to metal drums, it was stated that the epoxy resins should be suitable. The main problem at present was one of application and it was felt that much progress had yet to be made before a coated metal drum giving protection from corrosive liquids could be marketed.

Discussing the rigid or semi-rigid containers in plastics—polythene drums, plastic flexible tubes, etc.—the high cost of plastics was much criticised and chemical manufacturers wanted to know when and by how much they would become cheaper. It was felt that as the result of more mass production there was a good chance of price reduction, although perhaps not so much in the price of the polymer.

The screw caps on polythene drums and other containers came in for some criticism, and a number of delegates thought that a new type of design was required.

Only One Firm Uses Palletised Paper Sacks

OF the 15 or 20 companies represented at the discussion group on jute and paper sacks, only one—that of the chairman, Mr. A. F. Much (ICI, Manchester)—was at present exporting palletised loads in paper sacks. He felt it was worth while to experiment with shipments to the Continent to get the reactions of agents.

Attention was drawn to the fact that jute was now being married to other packaging materials. Mention was made of the new development of laminating a film on to cloth and turning it into sacks. It was agreed that the use of laminates promised an interesting future in both jute and paper sacks.

Conference Chairman's Review

REVIEWING the work of the conference, Mr. G. H. Edwards (Unilever) conference chairman, said that there was a feeling that there might be something in bulk transport, but how much? For the bigger firms bulk transport would be used more and more, but this might not be possible for the smaller firm unless there was some co-operative endeavour.

It had been mentioned that there would be packing points on the Continent, but, asked Mr. Edwards, would they use English packages or should they design continental styles? He felt that the packing materials makers might come up against competition in this respect.

It had been said that the square drum might be cheaper than the round one with less weight of material. In view of the mechanical handling facilities now available, the square drum should not cause difficulty because it could not be rolled.

A number of people had referred to the difficulty of making closures, whether for drums, sacks or plastics containers. The package industry must devote more study to this in the future.

Finally, Mr. Edwards said that the association had a packaging committee and if members wanted help from ABCM on packaging they should ask for it.

Boake Roberts Appeal Against Decision on Widnes Effluent Evaporation Plant

AN appeal against the refusal of the Widnes Town Council to grant authority for an effluent evaporation plant at their works in Dan's Lane, was made recently by A. Boake Roberts and Co. Ltd., Widnes, at a Ministry of Health and Local Government inquiry. Permission had been refused on town planning grounds that there was no guarantee against vapour, fumes or smell.

The alkali inspector for the area said that he could not give any assurance that there would not be an emission of fumes as his preliminary tests were inadequate, but he agreed that the tests did show that the firm was well within the safety limits. The emissions were not only very low but not serious, being less than 5 per cent of the maximum allowed by the regulations. The conditions at the times of his tests, however, were not wholly acceptable.

Mr. William Rootes (for A. Boake Roberts and Co.) said the firm made plasticisers, and that during the development it was necessary to provide an effluent evaporation plant. The council had intimated they might consider accepting the proposal providing that, if the council felt a nuisance had arisen, the company would install other apparatus and shut down the plant. The company felt that the council could not reasonably be considered the sole arbiters of a nuisance, particularly in an area where there were a number of other possible sources. It also overrode the specific provision which Parliament had given.

Mr. Thomas A. Mason, works director, said that originally it had been planned to produce a liquid effluent, but the laboratory process could not be put into production. He added: 'We ran into difficulties of design that necessitated a fairly late change and resulted in the production of a solution which included sodium sulphate. That could not be put into the River Mersey or the council's drains. It is inconceivable that this could exist as a gas'.

There was room to put in a scrubbing plant but the firm was not then prepared to spend a lot of money on something it felt would be ineffective and unnecessary. If there was to be an organic layer it would be on the top of the tank and arrangements could be made to recover it. Such a thing would be very exceptional.

Only the failure of the human element, or a complete breakdown of the plant, could lead to offensive smells coming from the works. If they were compelled to install new equipment it would mean shutting down for about six months.

The inspector visited the factory and announced that the Minister would give his decision in due course.

NEW FACTS ON INORGANIC CHEMISTRY OF NITROUS ACID

HITHERTO unknown facts concerning the inorganic chemistry of nitrous acid had been obtained during the course of the study of some organic reactions.

These were reported by Professor Sir Christopher Ingold at a joint meeting of the London section of the Royal Institute of Chemistry with the Sir John Cass College Chemical Society recently in a paper entitled 'An organic-chemical contribution to the inorganic chemistry of nitrous acid'. Of the two principal reactions of nitrous acid, namely, redox and electrophilic substitution, Sir Christopher said he would in fact be concerned with the latter only. In this case, reaction of an electrophilic reagent with a substrate (the molecule attacked) resulted in the transfer to the substrate of a group which was then bound by electrons supplied by the substrate. Of the possible carriers of the group X (e.g. NO) for the transfer of this group to the substrate the simplest would be X^+ (e.g. NO^+), others were of the type X–Y (e.g. NOBr) which might be an ion or molecule, but in which the ease of splitting off of the Y group as Y^- by the reaction $X–Y \rightarrow X^+ + Y^-$ would be an important factor in the efficacy of the carrier. A second important factor would be the limiting concentration of X–Y which might be present *as such* in the reaction medium.

Of the possible carriers of the NO group in, for example, nitrosation, the following, which were arranged in order of increasing basic strength of the combined base, could be considered:

NO^+, $NO.OH_2^+$, NO.Hal., $NO.NO_3$, $NO.NO_2$, NO.Ac, NO.OH.

Two of the reactions of nitrous acid, namely, the catalytic nitration of phenols and the diazotisation of aromatic amines, were selected for particular examination. In the first case two types of reaction were observed, the first being kinetically of zero order and due to the well-established course of nitration by the nitronium ion. The second reaction arose from the catalysis and was of second order, the reactions involved in acetic acid medium with nitric acid present in excess of the nitrous acid being:

$$ArH + \text{stoicheiometric } HNO_2 \xrightarrow{\text{slow}} ArNO + H_2O$$

and

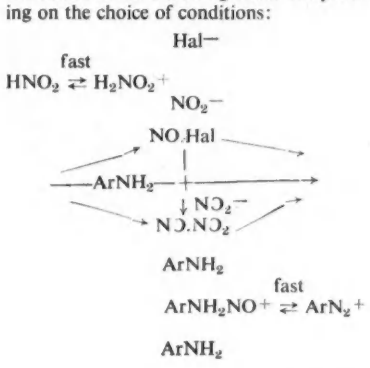
$$ArNO + HNO_3 \xrightarrow{\text{fast}} ArNO_2 + \text{stoicheiometric } HNO_2$$

It was known that under these conditions nitrous acid was present mainly as N_2O_4 molecules which would be slightly dissociated

$$2NO_2 \rightarrow N_2O_4 \rightarrow NON + NO_3N$$

Hence both NO^+ and N_2O_4 were possible carriers. Other possibilities were $H_2NO_2^+$, HNO_2, and N_2O_3, but these were not consistent with the observed kinetics of the reaction under various conditions. It had in fact been shown that although the concentration of NO^+ ion was considerably less than that of the N_2O_4 molecules, the nitrosonium ion was specifically the more powerful nitrosating agent.

In the case of the diazotisation of aniline and other aromatic amines in weakly acidic solutions containing small amounts of perchloric acid as the only strong acid, the list of possible carriers reduced to NO^+, $NO.OH_2^+$, $NO.NO_2$, and NO.OH. By means of studies of the effect of changes of reaction conditions, including addition of halide ion, when NO.Hal. became a possible carrier, on the kinetics it was found that the reaction could proceed by any of the routes in the following scheme depending on the choice of conditions:



Third ABCM Booklet on Work Study

ABOUT 80 per cent of the people employed in the chemical industry belong to companies who are applying work study in their organisations. A large number of smaller chemical firms, however, are not yet using work study, possibly because they consider that it can be applied only in large concerns. With this situation in mind, the Association of British Chemical Manufacturers has published a third booklet in the series, entitled 'Case histories from smaller firms and individual plants in the chemical industry.' This publication gives details of 21 case histories of applications in a wide variety of operations. Savings effected in these examples range from £200 per year in the case of a small materials handling problem to about £10,000 per year in an application to plant maintenance.

Copies of this latest booklet are available at 4s per copy, post free (cash with order) from the ABCM, 86 Strand, London WC2.

Training for Rubber Technologists

A training scheme for young men interested in a career in the technology of rubber and plastics is to be established at the Brynmawr factory of Semtex Ltd. It will cover young men from 16 to 18 who are interested in practical science.

In Parliament

UK'S ANNUAL RESEARCH EXPENDITURE

Annual research expenditure in Britain has been £300 million, or rather less than 2 per cent of the country's gross national product. Of this, about £225 million was provided in one form or another by the Government. This was stated by Viscount Hailsham, Lord President of the Council, on 25 March.

Lord Hailsham said that he was certain that viewing scientific research simply as an investment, the industrial and private contribution could with advantage be largely increased. He was also certain, he said, that Government departments, economists, private industrialists and financiers all paid too little attention to the results of research when these were published and pointed to known and concrete conclusions.

Synthetic Rubber Vital to UK Manufacturers

In view of the readily available natural rubber supplies at reasonable prices from non-dollar sources why had the President of the Board of Trade allowed imports of synthetic rubber last year of 58,000 tons from Canada and the US at a cost of $36 million? In reply to that question, Mr. J. K. Vaughan-Morgan, Minister of State, BoT, said that it was the Government's policy, so far as the balance of payments permitted, to allow UK manufacturers a free choice of materials. He added that for some uses synthetic rubber had technical advantages and that our manufacturers had to have it to compete on level terms in world markets.

Glycerine Agreement

Among agreements which are to be given priority by the Restrictive Practices Court is the one relating to the supply of glycerine. This was stated in the House of Commons recently by the President of the Board of Trade, Sir David Eccles.

Obituary

LESLIE H. G. GRIMWADE, technical director of Lever Bros. (Port Sunlight) Ltd., has died at the age of 53. He entered the company at Port Sunlight as a laboratory apprentice in 1920 and in 1937 he joined the technical staff at Unilever House. In 1945 and 1946 he served on the Control Commission in Germany, when he was in charge of the allocation of oils and fats. The following year he became technical director at Unilever House in London, and in 1950 he returned to Port Sunlight as production manager.

SIR JAMES SWINBURNE, F.R.S., who celebrated his 100th birthday last month (see CHEMICAL AGE, 1 March, p. 407) died on 30 March. Until 1953 he was chairman of Bakelite Ltd., and he will be chiefly remembered for his pioneer work in the field of plastics.

SOLVENT EXTRACTION OF METAL IONS

'THE use of long chain quaternary ammonium salts in the solvent extraction of metal ions' was discussed by Mr. R. Powell in a paper read to the Micro-chemistry Group of the Society for Analytical Chemistry recently. This use of long chain amines and quaternary salts was fairly well established in the analytical field as a means of separation, Mr. Powell said. Phenyl trimethyl ammonium iodide had been used for the precipitation of cadmium(1). Smith and Page(2) used methyl dioctylamine for the removal of mineral acid and from protein hydrolysates and Moore and his co-workers(3) had demonstrated the use of long chain amines in a number of important separations including niobium from tantalum, and uranium from sulphate liquors. Tetraphenyl arsonium and phosphonium salts were useful precipitants for perchlorate, permanganate, pertechnetate, etc. Moore(3) had drawn attention to the strong similarity existing between solvent extraction using amines and separations using anion exchange resins. In the latter case the active N^+ sites were distributed in a resin matrix whereas in the former case the active N^+ sites were dispersed in an inert diluent such as benzene or chloroform. Solvent extractions comparable with cation exchange were also known; e.g. ferrous dipyridyl, $Fe^{++}(dipy)_3$ could be extracted into inert solvents in the presence of alkyl sulphates(4).

Determination of Pu

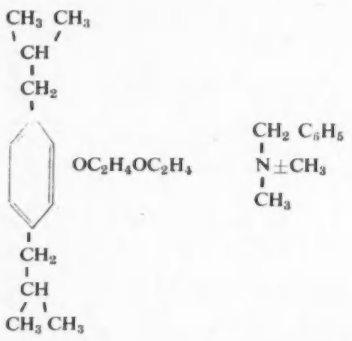
Use had been made of this type of solvent extraction for the separation and determination of plutonium in solutions of irradiated uranium. Normally there was present in such solutions a large excess of uranium and the determination of the plutonium presented a difficult problem for the analyst. Such solutions were highly radioactive and operations had to be conducted behind shielding. The usual method for the determination of plutonium in these solutions was by counting the α particles emitted. It was necessary to correct such counts for α particles emitted by elements other than plutonium and even if this could be done accurately one had to know the isotopic composition of the plutonium before the counting rate could be converted to a weight of plutonium. Attempts were made therefore to determine plutonium by non-radiometric means.

Mr. Powell reported that tetravalent plutonium in nitric acid of $>7M$ formed the acid complex $Pu(NO_3)_6^-$ which imparted a deep green colour to the solution. This might be retained on anion exchange resins to separate it from uranium and most of the fission elements which were not complexed in 7M nitric acid. The subsequent recovery of the plutonium, however, was not quantitative. It could also be extracted into a number of solvents such as polyethers, ketones and alkyl phosphates, but such extractions were not sufficiently selective to be employed analytically. The long chain quaternary ammonium salts were therefore considered for this purpose and found to be extremely useful.

These compounds were not available as pure reagents but a wide variety was available as industrial wetting agents or detergents. They were generally sold as the chlorides or sulphates which were water soluble. Addition of nitric acid caused the nitrate to precipitate or separate as an oil. The nitrates were extremely insoluble in water but extracted into inert solvents.

After conversion of the plutonium to the tetravalent state the nitric acid solution was shaken with a solution of the quaternary nitrate in benzene or chloroform when the plutonium was transferred to the organic phase.

A large number of compounds was examined to determine their use as extractants for plutonium and the most successful was Hyamine 1622. This is made in the US by Rohm and Haas and is stated to be paradiisobutylphenoxyethoxyethyldimethylbenzyl ammonium chloride:



A 1 per cent solution of the nitrate in benzene removed 99.5 per cent of the plutonium from an equal volume of 5M nitric acid in the absence of uranium. In the presence of a large amount of uranium 98 per cent of the plutonium was removed from 2M nitric acid. The solvent was freed from traces of uranium by washing with 5M nitric acid. Decontamination from fission product activity was greater than a factor of 10^4 so that the solvent extract could be handled without shielding.

Plutonium was one of the very few elements forming acid nitrates in 4–5M nitric acid and the separation was therefore almost specific for plutonium, said Mr. Powell. Because of this it was possible to complete the determination using a simple colorimetric procedure. Thoronol (the sodium salt of 1-(o-arsonophenylazo)2-naphthol-3:6 disulphonic acid) was a sensitive colorimetric reagent for a number of tetravalent elements. It was water-soluble, but the acid could be extracted into a benzene solution of a long chain quaternary compound such as Hyamine 1622. A solution of thoronol in hyamine/benzene was therefore added to the plutonium solution in the same solvent, in the presence of alcohol, and the resulting colour measured with a Spekker absorptiometer.

Normally about 20 micrograms of plutonium were required in an analysis, the limit of detection being about 1 microgram.

ACKNOWLEDGEMENT

*The 'Hyamine 1622' used in these experiments was supplied by Charles Lennig.

REFERENCES

(1) Pass and Ward, *Analyst*, 1933, **58**, 667.
(2) Smith and Page, *J. Soc. Chem. Ind.*, 1948, **67**, 48.
(3) Moore, F. L., *Anal. Chem.*, 1957, **29**, 1660.
(4) Powell and Taylor, *Chemistry and Industry*, 1954, 726–727.

**Since the completion of this work Goldschmidt (1955 Conference at Geneva: The peaceful uses of atomic energy) has reported on the solvent extraction of tetravalent plutonium with the aid of long chain quaternary ammonium compounds.*

Fluorine Chemistry Symposium

A SYMPOSIUM on 'Recent developments in the chemistry of fluorine' is to be held on 11 April at Manchester University. Organising the symposium are the Chemical Society, the Institute of Petroleum, the Royal Institute of Chemistry and the SCI.

Speakers are: Dr. J. S. Rowlinson (Manchester University), 'The physical properties of fluorine compounds', Mr. H. R. Leech (Imperial Chemical Industries Ltd., Widnes), 'Production and availability of fluorine compounds', Mr. J. Muray (Imperial Chemical Industries Ltd., Widnes), 'Organic fluorinations using halogen fluorides and fluorine', Dr. W. K. R. Musgrave (Durham University), 'Oxidation of aromatic hydrocarbons with peroxytrifluoroacetic acid', Professor R. N. Haszeldine (Manchester College of Science and Technology), 'Fluorocarbons containing functional groups', Dr. J. C. Tatlow (Birmingham University), 'Nonafluorocyclohexanes and derived compounds', and Dr. R. Stephens (Birmingham University) 'Fluoroaromatics from polyfluorocyclohexanes'.

Geigy Increase Sebacic Acid Plant Capacity

EXTENSIONS recently completed at the Trafford Park, Manchester, plant of the Geigy Co. Ltd. will give a 40 per cent increase in production of sebacic acid. These extensions are part of a plan which will eventually double the original UK production of this material.

Geigy and their associates in Europe and the US claim that they already produce the major part of the world's supply of sebacic acid.

Sebacic acid is used in the manufacture of plasticisers, synthetic lubricants, for jet and turbo-prop air engines, and nylon 6-10. An important by-product is capryl alcohol used in the manufacture of plasticisers and in oil and petrol additives.

ICI Donations to Leeds University

ICI Ltd. have donated the sum of £300 to the department of inorganic and structural chemistry at Leeds University. The university's department of textile industries has received £500 from ICI fibres division.

Overseas News

AUSTRALIA'S TRADE MINISTER ANNOUNCES IMPORT PLANS FOR NEW LICENSING YEAR

NO reduction is being made in Australia's import ceiling of approximately £A.800 million annually in the four-month licensing period which began on Tuesday. Certain basic raw materials will be exempt from licensing within this ceiling. Licensing procedures for certain dollar area goods are being simplified and it is proposed to licence more goods without discrimination against dollar area sources.

A number of basic raw materials which are already being licensed to full requirements are now to be exempt because of their importance to the economy. Goods to be so treated are nickel ingots and shot, narcotics, drugs, rock phosphate, some fertilisers (mainly muriate and sulphate of potash) ferrous alloys, abrasives, mercury, razorite, cryolite and vermiculite ore.

Goods to be licensed by the Trade Department without dollar discrimination include nickel anodes, boric acid, boron salts, petroleum jelly for industrial use.

The following goods will be handled directly by customs collectors without dollar discrimination: graphite and plumbago, castor oil, palm oil, magnesite (dead-burned), mastic, fluorspar and earths and clays other than bentonite.

Titanium dioxide is included in goods to be licensed on a replacement basis without dollar discrimination.

Shell Open Alkylate Plant at Pernis

A plant to produce alkylate has been opened by the Shell refinery at Pernis. This is the first alkylate factory in Western Europe. Previously this component for aviation spirit has been imported.

Organophosphates Plant in Canada

Organic phosphates are shortly to be manufactured on a commercial scale in Canada for the first time by Electric Reduction Company of Canada, Ltd., one of the Albright and Wilson group of companies. Production is to start on 1 May at ERCO's recently expanded Buckingham (Quebec) plant.

The present $500,000 annual Canadian market for organic phosphates has until now been supplied by exports from the US and Europe. An important Canadian use for organophosphates is in the solvent extraction of uranium.

US Titanium Market Remains Soft

Production of titanium sponge by Cramet of the US has now ceased. The company's $25 million plant at Chattanooga, Tennessee, is to be handed over to the Government so ending the Government's obligation to purchase the greater part of the plant's 6,000-ton-a-year output. The General Services Administration, it is reported, will shut the unit down. Dow Chemicals' plant also remains idle and the US titanium market as a whole is stated to remain soft.

Dow Produce Allyl Alcohol

Allyl alcohol has been introduced in commercial quantities by Dow Chemical International Ltd., an export subsidiary of the Dow Chemical Co.

As a chemical intermediate allyl alcohol is used in the production of resins, pharmaceuticals, flavourings and perfumes, functioning primarily as an intermediate for such esters as allyl isothiocyanate, diallyl phthalate, allyl caproate and allyl methacrylate. It is possible to use allyl alcohol as an intermediate in the production of acrolein.

Dow's allyl alcohol has a minimum assay of 98 per cent. The company hope to have allyl chloride commercially available in June or July.

New Herbicidal Compounds Based on Trichlorobenzoic Acid

Commercial production of a new group of herbicidal compounds based on 2,3,6-trichlorobenzoic acid has been initiated by Heyden Newport Chemical Corporation at newly completed facilities at Fords, New Jersey, US. Herbicides based on the new compounds are said to show outstanding promise for control of bindweed and other deep-rooted perennial weeds on agricultural lands and industrial sites at reasonable cost. Their effectiveness against persistent weed species at economic dosage levels has been demonstrated repeatedly, the company state, in a co-operative programme of several years' duration with weed control authorities throughout the US.

Sulphur and Sulphuric Acid Usage in Australia

Analyses showing the consumption of sulphur and sulphuric acid in Australia in 1956–57 and trends in their consumption compared with earlier years have been given recently by the Australian Sulphuric Acid Executive Committee of the Department of Defence Production and is reproduced below.

Trends in Usage of Elemental Sulphur

Applications	1951/52 tons	1951/52 %	1953/54 tons	1953/54 %	1956/57 tons	1956/57 %
Sulphuric acid	129,783	92.98	146,368	95.02	148,908	94.46
Chemicals (general)	1,517	1.09	1,201	0.78	3,956	2.50
Agricultural and horticultural	4,540	3.25	2,107	1.37	2,081	1.32
Rubber vulcanising	1,333	0.95	1,600	1.04	1,648	1.04
Mining and metallurgical	428	0.31	616	0.40	608	0.39
Foods	1,120	0.80	752	0.49	216	0.14
Others	1,003	0.62	1,384	0.90	238	0.15
Totals	139,724	100.00	154,028	100.00	157,655	100.00

Trends in Usage of Sulphuric Acid

Applications	1947/48 tons	1947/48 %	1951/52 tons	1951/52 %	1953/54 tons	1953/54 %	1956/57 tons	1956/57 %
Superphosphate	411,007	83.34	547,391	83.13	606,093	82.85	670,276	75.89
Ammonium sulphate	37,650	7.63	46,243	7.02	54,332	7.43	82,763	9.37
Mining and metallurgical	19,281	3.91	18,098	2.75	24,976	3.41	43,117	4.88
Chemicals	18,714	3.79	24,789	3.76	20,371	2.78	30,796	3.48
Paints and pigments	300	0.06	10,995	1.67	14,190	1.94	22,934	2.60
Petroleum products	196	0.04	970	0.15	1,261	0.17	9,589	1.09
Textiles	2,307	0.47	2,305	0.35	3,565	0.49	9,440	1.07
Accumulators	1,029	0.21	2,425	0.37	2,346	0.32	2,826	0.32
Foods and drinks	1,292	0.26	3,160	0.48	1,340	0.18	1,553	0.17
Tanning	964	0.20	1,100	0.17	1,397	0.19	1,020	0.12
Others	443	0.09	1,014	0.15	1,776	0.24	8,893	1.01
Totals	493,183	100.00	658,490	100.00	731,647	100.00	883,207	100.00

Exports of Tunisian Phosphates

France was the largest customer for Tunisian phosphates in 1957, importing a total of 787,293 tons. Other importing countries were: Italy, 723,286 tons; UK 657,032 tons, West Germany, 549,321 tons; Spain 404,738 tons; and Belgium 391,900 tons. Exports of phosphates from Tunisia last year totalled 5,431,813 tons, compared with 4,904,608 tons in 1956.

National Starch Products To Occupy Larger Quarters

National Starch Products Inc., manufacturers of corn starches, vinyl resins and adhesives, will occupy new and larger quarters in a recently completed 34-storey building at 750 Third Avenue, New York.

National Starch Products have several plants in the US and Canada plus foreign operations in the UK and Holland.

Amino Acids Formed

Research workers at General Mills Research Laboratories, Minneapolis, Minnesota, US, have used atomic radiation to form amino acids. Their experiments indicate that radiation may have been the cosmic tool which formed the first amino acids, which subsequently were transformed into the first cell and finally into man. In these experiments ammonium carbonate was irradiated under vacuum in a sealed glass tube with 500 million roentgen of gamma rays. It was found that amino acids were formed.

Reinforced Epoxy and Silicone Structures

High mechanical and dielectric strength at sub-zero and elevated temperatures and dimensional tolerances of 0.001 in., are claimed for a new seamless, glass-reinforced epoxy and silicone structure developed by Chemfab Corporation, Long Island City, NY, US. The company specialises in custom reinforced plastics research, development and manufacture for industry and the military.

Produced in tubular and other forms,

the new materials are already being used as rigid conduits for corrosives.

Design of reinforcement and greater length are two of the major differences between these 'Chemtube' structures and conventional ones. 'Chemtube' utilises continuous, tubular reinforcement of glass fibres, braided especially to stress requirements of structures. Walls, as thin as .015 in., are possible without 'steps', seams or joints.

The impregnant in the new epoxy structures is a high-temperature epoxy-CL system which provides a service temperature range of from −320 °F to +400 °F. Other characteristics include dielectric strength up to 500 volts mil thickness; compressive strength of 22,000 p.s.i.; tensile strength (tube) 22,200 p.s.i.; and flexural strength (fibre stress) of over 32,000 p.s.i. Water absorption is limited to 0.24 per cent.

Chemtube silicone structures utilise specially formulated silicone resins which impart good mechanical and electrical properties and provide a service temperature range up to 200 °C (392 °F).

Current production is now seven to eight feet on the round and two feet on the square and rectangular epoxy structures. Epoxy tubing is centreless ground to diameters ranging from $\frac{1}{4}$ in. to 2 in. i.d., with wall thickness starting at 0.015 in. I.d.s as small as $\frac{1}{16}$ in. have been made. Silicone Chemtube is produced in square and rectangular cross-sections, in lengths of from 18 in. to 2 feet.

Synthetic Paper from Nylon

Synthetic paper made from artificial fibres such as nylon is to be manufactured by the Special Paper Mfg. Co., Japan. The process for making these synthetic papers was developed by the Okamura Technology Laboratory of Kyoto University. It is believed that the Japanese system is the first on a commercial basis, although synthetics have been produced in Germany and the US by other methods. Price of the new papers is expected to be four times that of ordinary kinds.

Olin Mathieson to Close Morgantown Plant

Operations by the Olin Mathieson Corporation at the Morgantown, West Virginia, Government-owned plant where ammonia and methanol are produced, are to cease. The company say this decision has been taken owing to the cost of operation and increasing outside competition in markets for the two chemicals, The plant will stop operating by the middle of this year.

Net rental for the facilities totalled about $6 million last year, it is reported.

Italian Foreign Trade in Chemical Products

During the past 8 years, Italy has expanded both her imports and exports of chemical products although the increase in exports has not kept pace with the increase in imports, making an adverse balance. The gap narrowed in 1957, but it is not yet possible to predict whether a diminution in the adverse balance will continue into 1958.

ITALIAN CHEMICAL INDUSTRY EXPANSION CONTINUES

THE post-war expansion trend in the Italian chemical industry continued last year, although there was a certain slowing down. This is apparent, writes our Italian correspondent, from preliminary data published by Confindustria (Italian Confederation of Industrial Associations). Stocks of chemicals in hand were slightly below the 1956 level.

A slight downward trend for prices was also noted, although in a number of cases, increases were forced by higher production costs. Most notable price reductions were recorded in chemical fertilisers and anticryptogamics.

Utilisation of plant capacities varied considerably, but in the case of the bigger companies, it fluctuated between 75 and 100 per cent. The production of sulphuric acid registered a slight increase over the high level of 1956. There was a slight drop in the output of synthetic ammonia in the early half of 1957, but although there was some improvement later in the year, it is not yet possible to say whether total production matched the 1956 figure.

During the 1956-57 season, production of nitrogenous fertilisers increased by 7.9 per cent. Of the total, 11 per cent were compound fertilisers. Production of ammonium nitrate showed a considerable increase; calcium cyanamide declined heavily and ammonium sulphate and calcium showed no change. Output of phosphatic fertilisers rose by 2.2 per cent, while consumption fell by 3.1 per cent. There was a fall of about 13.8 per cent in the consumption of superphosphates. There were increases in the cases of both binary and ternary compound fertilisers.

Output of calcium carbide matched the 1956 level, but Italian exports were adversely affected by the growing importance of South African carbide.

Production of electrolytic caustic soda is estimated to have increased by about 25 per cent compared with 1956. Increases were also recorded in the cases of chlorine gas, liquid chlorine and hydrochloric acid.

Potential of plants producing methyl alcohol (now wholly from methane) was raised by about 15 per cent to meet higher demand. Production and exports of acetic acid and acetic anhydride were both up. Output of acetone rose by some 25 per cent. The petrochemical route to this substance gained ground steadily at the expense of the fermentation process, while the use of calcium carbide has been eliminated.

Output of phthalic anhydride rose considerably while that of tartaric acid and citric acid remained static. Production of benzole increased by 8-9 per cent and that of naphthalene remained at the 1956 level.

A slight increase in the production of synthetic organic dyestuffs was noted but prices still do not cover production costs.

The most cheerful sector of the Italian chemical industry in 1957 was that of synthetic resins and plastics materials. Noteworthy production increases were registered for polystyrene and p.v.c. while polythene remained at the record 1956 level.

Outputs of starch and dextrin increased, and that of glucose rose by about 13 per cent.

Production of pharmaceuticals was not entirely satisfactory owing to several local factors, but exports rose by 20 per cent in the first three quarters of 1957.

Soaps and stearine showed little movement over 1956 levels, but synthetic detergents went ahead and it is now estimated that last year some 65,000 tons were produced.

DIARY DATES

TUESDAY 8 APRIL

SCI Chemical Engineering Group—London: 14 Belgrave Square SW1. 5.30 p.m. 'Evaporation of temperature sensitive materials' by B. N. Reavell and G. A. Goodwin.

WEDNESDAY 9 APRIL

SCI Food Group Nutrition Panel—London: 14 Belgrave Square SW1. 6.15 p.m. Annual general meeting.

THURSDAY 10 APRIL

OCCA—London: The Laboratories, J. Lyons and Co. Ltd., Hammersmith Road W14. 2 p.m. Works visit.

SCI Microbiology Group—London: Queen Elizabeth College, Campden Hill Road W8. 6 p.m. Annual general meeting followed by 'Nucleic acids, what, where and why' by E. F. Gale.

FRIDAY 11 APRIL

British Paper & Board Makers' Assoc.—Manchester: Engineers' Club, Albert Square. 'Butadiene-methyl methacrylates latices for the paper industry' by N. D. McLeod and J. H. Wilson.

CS, Inst. of Pet., RIC & SCI—Manchester: Large Chemistry Lecture Theatre, The University. All-day symposium on 'Recent developments in the chemistry of fluorine'.

ICI To Step Up Methanol Output

THE METHANOL plant at the Heysham works of ICI Billingham division is to be expanded. One report quotes a planned increase of 15 to 20 per cent in methanol production, with plant costing between one and two million pounds. Construction will take about two years, and the plant will be similar to that already at Heysham, but in a more modern form with automatic control equipment. One of the main uses for methanol is for formaldehyde production used in the manufacture of plastics.

A. Scientists Pay Claim

The pay claim for 8,000 atom scientists and technicians (the largest is for another £2,350 for senior scientists) presented by the Institution of Professional Civil Servants (see CHEMICAL AGE, 25 January, p.197) has been rejected. It is believed that the claim may now go to arbitration.

WORK ON ETHYLENE-PROPYLENE COPOLYMERISATION BY NATTA

COPOLYMERISATION of ethylene with propylene was discussed recently by G. Natta, G. Mazzanti, A. Valvassori and G. Pajaro (*Chim. e Ind.* (Milan), 1957, **39**, 733, 743, 825). With the help of special systems of catalysts they succeeded in obtaining very high-molecular, linear, amorphous ethylene copolymers with aliphatic α-olefines free of homoeopolymers. Suitable catalyst systems were selected from among those which polymerise ethylene as well as α-olefines and chiefly yield atactic products by the polymerisation of α-olefines. The polymerisation was carried out by continuous circulation at very high speed of a monomer mixture of constant composition. Copolymers virtually free of homoeopolymers were obtained with the catalysts produced, for instance, by letting aluminium trihexyl act on vanadyl chloride.

Fractionation of the co-polymerisation products by extraction with solvents and comparison with solvent fractionation of homoeopolymers produced under similar conditions shows the ethylene-propylene copolymers, in contrast to the mixtures containing homoeopolymers, to be fully extractable by means of boiling n-heptane. X-ray examination shows the copolymers to be quite amorphous and the absorption maximum of the amorphous products to differ apparently from those containing homoeopolymers.

IR measurements revealed substantial differences between the absorption spectrum of the copolymers and that of the corresponding homoeopolymers and prove the existence of short methyl sequences in the chain. Entirely different are the mechanical properties which for the described copolymers show viscoelastic properties corresponding to those of a good non-vulcanised elastomer. Methods of analysis developed for determining the composition of the copolymer and its fractions were described.

Radiochemical Method

A radiochemical method is based on the use of ethylene marked 14C, and an IR method measures the intensity of absorption at 7.25μ. It was found that, other factors being equal, the composition of these copolymerisation products was generally independent from the concentration of the catalyst, the duration of the polymerisation process, the time which had elapsed between production and use of the catalyst, and the mol ratio of the aluminium trihexyl and vanadyl chloride used for the preparation of the catalyst.

G. Mazzanti, A. Valvassori and G. Pajaro ('Copolymerisation of ethylene and propylene with catalysts based on aluminium trihexyl—vanadyl chloride') have determined the connection between the composition of the mixture of monomers and that of the copolymers formed, and drawn diagrams showing how the mol share of ethylene in copolymers varies when the mol fraction of solute propylene in the total of solute monomer changes. The results were evaluated by using the Lewis-Mayo copolymerisation ratio, and the reactivity ratios of the two monomers were calculated. They were: $rC_2H_4 = 17.95$; $rC_3H_6 = 0.065$.

The value of the product of the reactivity ratios determined by them is very close to 1, and this is in agreement with the fact ascertained by Flory that in copolymerisations with ionic mechanism this product is almost always much closer to 1 than in those with radical mechanism. That the reactivity ratio of propylene is very much lower than that of ethylene is, in view of the presence of nucleophilous methyl sidegroup, in accordance with what can be foreseen for a copolymerisation with anionic reaction mechanism.

Ethylene-propylene copolymerisation with catalysts obtained by letting aluminium trihexyl act on vanadium tetrachloride yielded, in continuous reaction, ethylene-propylene copolymers with a high molecular weight free of homoeopolymers (G. Mazzanti, A. Valvassori and G. Pajaro). They are amorphous products with a characteristic IW spectrum and a solubility differing from that of a mixture of homoeopolymers with copolymers. Their composition does not depend on the concentration of the catalyst, on the time of ageing of the catalyst or on the mol ratio of aluminium trihexyl and vanadium tetrachloride. Their composition is, however, greatly influenced by the composition of the mixture of monomers. When the composition of the mixture of monomers was varied from 5 to 65 mol per cent of ethylene, copolymers were obtained with an ethylene content between 10 and 80 mol per cent. By reference to the mol fractions of the monomers in the liquid phase the following values were obtained for the reactivity ratios: $rC_2H_4 = 8.08$; $rC_3H_6 = 0.088$.

Russian Scientist's Views on Adhesion in Relation to Chemistry

PROBLEMS of adhesion are important to a number of industries and amongst workers in this field the Soviet physical chemist B. V. Deryagin is recognised as one of the leading authorities. His theory concerning the occurrence of an electrical double-layer at the adhesive-substrate interface, and the effect of the electrostatic forces involved on the strength of the adhesive bond, has already been published in English (1). In a later paper (2) he and his co-workers have examined the adhesion to glass of a series of cellulose esters and ethers, vinyl polymers, natural rubber and gutta-percha. In addition, the variation in adhesion of nitrocellulose to a number of polymers such as nitrile-rubber and polyethylene was measured. The strength of the bond was characterised by the work done in stripping the film of adhesive from the substrate, under the action of a falling weight.

The method used for ensuring absolute cleanliness of the glass is of interest. For this purpose the glass was placed in the path of a 700-volt gas-discharge at 0.4 to 0.6 mm. Hg pressure. Failure to carry out this process led to a marked reduction in adhesion.

In all measurements on glass it was found that at very low rates of stripping adhesion was independent of rate, an intermediate region followed in which the work of stripping increased with increasing rate, and finally at very high rates the work done was again independent of rate. The authors show how this observation is in complete accord with the electrostatic theory.

It was noted that if the cleaned glass were first placed in an atmosphere saturated with water vapour, which leads to the formation of an adsorbed layer of water on the surface, in no case was there any reduction in adhesion of a polymer subsequently applied. In some instances there was actually an increase. On the other hand thin layers of certain substances such as stearic acid or a silicone grease, adsorbed on to the glass from the vapour phase, greatly weakened the adhesive bond.

From the results obtained it is concluded that highest adhesion is given by polymers containing functional groups that are (a) capable of exchanging electrons or protons with the substrate, thus giving rise to a high electrostatic charge density at the interface and (b) can orientate to give a high packing density on the surface of the substrate. Such groups should preferably be present in both the adhesive layer and the substrate.

All the results are considered to give support to Deryagin's electrical double-layer theory of adhesion.

REFERENCES.

(1) B. V. Deryagin, *Research*, 1955, **8**, 70.

(2) N. A. Krotova, Yu. M. Kirillova and B. V. Deryagin, *Zhur. Fiz. Khim.*, 1956, **33**, 1921.

Uses of Terylene In Industry

'TERYLENE IN INDUSTRY' is the subject of a new booklet published by ICI Ltd. Printed in English, German, Swedish and Spanish, it is sectionalised to cover marine uses, chemical industry, laundry and dyeing, tarpaulins and insulation fabrics, belting, hose, air uses, sewing threads, venetian blinds and safety harness.

Among main uses suggested for the chemical industry is that of filtration and it is stated that a Terylene filter for a sulphuric and hydrochloric acid mixture lasted 700 filtrations, while natural fibre cloth was useless after 15 filtrations. Terylene filter cloths are also being used for hot gas, water, electro-plating, oilseed crushing, sugar and fertiliser manufacture.

PEOPLE in the news

● MR. CECIL E. HORTON, a director of Fisons Ltd., left Liverpool on 21 March for St. John on board the *Empress of Britain*.

● The following personnel have been appointed by British Resin Products Ltd. in connection with the development of sales of their Rigidex high density polythene: sales manager, J. D. WINSTON; assistant sales manager, G. E. H. SMOCK; development manager, D. N. DAVIES; service manager, P. BROWN.

● DR. M. A. T. ROGERS has been appointed research controller of Imperial Chemical Industries Ltd. He succeeds MR. R. M. WINTER who is retiring after thirty years' service.

M. A. T. Rogers

Dr. Rogers was born at Mill Hill in 1911, and received his B.Sc. and Ph.D. from University College, London, where he was a Tuffnell Research Scholar and the Ramsey Memorial Medallist for 1933. Dr. Rogers joined the dyestuffs division of ICI as a chemist in 1934, and served in the azo section until 1936, the textile auxiliary section until 1939 and the exploratory research section until 1942. After military service he became engaged on penicillin research with Sir Robert Robinson at the Dyson research laboratory, Oxford. In 1946, Dr. Rogers joined the medicinal research division of dyestuffs division, and in 1949 he became head of the academic relations department of the division.

Mr. Winter was born in Scotland in 1896 and emigrated in early childhood to New Zealand. He joined Synthetic Ammonia and Nitrates Ltd. (now the Billingham division of ICI) in 1928 and was transferred to the ICI general chemical division as research manager in 1931. In 1937 he moved to head office as chief assistant to Dr. Slade who was then research general manager and was appointed research controller in 1946.

● DR. G. A. H. ELTON at present reader in applied physical chemistry at Battersea College of Technology has been appointed director of research of the British Baking Industries' Research Association. He is taking up his duties on 1 May.

He was awarded a Ph.D. at London University for a thesis on colloid chemistry and subsequently a D.Sc., also at London University, based on this work and on a number of papers which he published in the field of rheology.

● MR. PHILIP SELLARS has joined the board of Southern Instruments Ltd. as vice-chairman. He will be responsible for overall co-ordination of the company's activities.

● PROFESSOR KURT PETERS, professor of fuel chemistry at Vienna Technical University, is visiting the UK under British Council auspices. From now until Easter he will visit research laboratories and technical colleges in and around London.

On 27 March he went to the Fuel Research Station in Maze Hill and on 28 March he visited the Leatherhead Central Electricity Research Laboratories and the British Coal Utilisation Research Association.

● MR. E. M. FRASER, C.B.E., sales controller of ICI Ltd., retired on 31 March after more than 38 years with the company and its predecessors. He has been succeeded by MR. J. H. TOWNSEND, deputy sales controller. During the second world war, Mr. Fraser was Director-General of Aircraft Production. He has been a member of the ABCM council and of the Television Advisory Committee. Mr. Townsend who joined the Billingham division in 1935 became deputy sales controller in 1953.

● Officers elected by the retiring committee of the agriculture group, Society of Chemical Industry for 1958/59 are: chairman, DR. O. OWEN, scientific adviser to Pollards Nurseries Ltd.; vice-chairman, DR. A. H. CORNFIELD, lecturer in agricultural chemistry, Imperial College; hon. secretary, DR. P. W. ARNOLD, Rothamsted Experimental Station; hon. treasurer, DR. J. H. HAMENCE, president, Society for Analytical Chemistry; hon. recorder, DR. I. D. MORTON, food research department, Unilever.

● Albright and Wilson Ltd. have appointed DR. FORREST F. MUSGRAVE, D.Phil., F.R.I.C., as personal assistant to Mr. Sydney Barratt, chairman. Dr. Musgrave was formerly managing director of Lubrizol Great Britain Ltd.

F. F. Musgrave

Canadian-born, Dr. Musgrave graduated in chemistry at Dalhousie, and then as a Rhodes Scholar took a doctorate in physical chemistry at Oxford. After early experience with Imperial Oil Ltd., a Canadian subsidiary of Standard Oil, he joined the Lubrizol Corporation of Cleveland, Ohio, as chemical research director, later becoming technical assistant to the president. Dr. Musgrave was closely concerned in the establishment in the UK of Lubrizol Great Britain Ltd., formerly known as Anglamol Ltd.

● DR. H. H. R. REINERT, has become head of the new pharmacological research unit established by Pfizer Ltd. at Sandwich, Kent. After qualifying as a doctor of medicine in 1947, Dr. Reinert was appointed in 1953 to the National Institute of Medical Research at Mill Hill, London. Before joining Pfizer he was senior pharmacologist at Glaxo Laboratories.

Recently appointed as research chemists are: DR. W. H. HUNTER, who obtained a Ph.D. in organic chemistry at Queen's University, Belfast and has studied in the US, MR. W. C. AUSTIN, who joins the company from Allen and Hanburys Ltd. and DR. C. R. WORTHING. Head of chemical research is DR. R. J. BOSCOTT, who was lecturer in endocrinology at Birmingham University before joining Pfizer in March last year.

● MR. F. L. CLARK, B.Sc., M.Sc., research manager of South African Explosives and Chemical Industries Ltd., has been awarded the D.Sc. by the University of South Africa. His thesis was on the determination of the half-life and alpha particle activities of some radioactive isotopes. He hoped to gain a Ph.D., but the examiners were so impressed that they awarded him the higher degree. Before going to South Africa in 1952, Dr. Clark was senior technologist in the technical department of ICI's Billingham division.

● MR. NORMAN L. HOLMES, F.R.I.C., who recently gave the seventh Atkin Memorial Lecture at the leather industries department, Leeds University, is a director of Richard Hodgson and Sons Ltd., Beverley, whom he joined as a chemist nearly 40 years ago. His subject was 'A philosophy of tanning'.

● MR. W. H. GRINSTED, director of engineering of Siemens Edison Swan Ltd., has retired. Born at Slinfold, Sussex, he received his education at the Central Technical College (now Imperial College) London, where he held the Clothworkers scholarship and won the Siemens Medal.

● On board the Cunard liner *Queen Elizabeth* sailing from Southampton for New York via Cherbourg on the 27 March, was MR. T. MARTIN, chairman and managing director, Anchor Chemical Co. Ltd., Manchester.

● DR. H. A. THOMAS, manager of Courtaulds' Use Development Organisation, Manchester, has been appointed acting chairman of the new textile and paper chemicals group of the Society of Chemical Industry. The new group will give particular attention to the manufacture of purified cellulose, modified urea and other resins, cellulose esters, bulk delivery of heavy chemicals, chemistry of dyestuffs and auxiliaries.

● MR. H. PICKARD has been appointed a director of the APV Company.

Commercial News

ICI's Sales, Profits and Dividend Up and 50% Scrip Issue Proposed

FINAL dividend on the ordinary stock of Imperial Chemical Industries Ltd. has been raised by 2 per cent to 8 per cent making with the interim of 4 per cent a total of 12 per cent for the year 1957 (10 per cent for 1956). A scrip issue of 1-for-2 has also been proposed.

Group sales to external customers have risen from £435 million to a new peak of £436 million and last year's group income, before tax, is up from £51.1 million to £55.1 million. This is struck after charging £24.5 million, against £23.4 million, for depreciation and £4.9 million, against £3.1 million in respect of the employees' profit-sharing scheme. The tax charge has risen from £23.7 million to £26.3 million. However, group income, after tax, is up from £26.3 million to £28.8 million. Allocation to replacement of assets reserve is repeated at £7 million, £1.5 million (£2.5 million) goes to general capital reserve and £5.2 million (£1.3 million) is transferred to general revenue reserve. From stock replacement reserve £2.5 million had been transferred against £750,000 in 1956.

The scrip issue, which has received Treasury consent, will necessitate the capitalisation of £72.18 million of capital and revenue reserves of £171 million. Subject to the proposals being approved at the extraordinary general meeting, the company hope to issue allotment letters on 27 June to ordinary stockholders registered on 30 May. The board of directors stress that no inference should be drawn from the proposed scrip issue as to the rate of ordinary dividend which the board may propose for 1958 or any subsequent year.

Shares to be issued under ICI's employees' profit-sharing scheme in respect of the bonus year 1957 will not be allotted until after 30 May this year and will not therefore rank for the proposed scrip issue. In the event of the scrip issue being approved, members of the scheme will be credited for the bonus year 1957, with the same amount of ICI ordinary stock as they would have received if the shares issued for that bonus year had ranked for the scrip issue.

Air Liquide

Oxygen manufacturers, Air Liquide of France, announce a dividend of Frs.650 per share of Frs.2,500 (same) plus a dividend of Frs.325 in new shares issued in 1957.

Blythe Colour Works

Erratic and fluctuating economic conditions last year are reported to have had a disturbing influence on Blythe Colour Works Ltd. who manufacture colours, stains, oxides, enamels, glazes and chemical products for the pottery, plastics and rubber industries.

Consolidated net profit at £131,186 showed a fall due to the absorption of rising costs in an effort to keep down selling prices. A final ordinary dividend of 6d a share, less tax, is being paid.

Reference was made by the chairman, Mr. D. R. Wildblood, to keener overseas competition. Prompt delivery and efficient service were essential, he said, and it was also necessary to swallow ever-increasing costs in order to keep prices down and retain existing business.

The Australian subsidiary is reported to be well established now and to have enjoyed another successful trading year.

Glaxo Ltd.

In the six months ended 31 December 1957, group trading profits of Glaxo Laboratories Ltd. of £2,509,000 compare with £1,601,000 in the same period of 1956. Of this £1,240,000 is attributable to the parent company (£790,000). The interim dividend is being raised from 5 per cent to 6¼ per cent on account of the year ending 30 June 1958. Total payment in 1956-57 was 12½ per cent.

Group turnover, excluding sales of South African subsidiaries, increased by 24 per cent over the corresponding period a year ago and by 5 per cent compared with the six months ended 30 June 1957. With one minor exception, all the companies within the group contributed to the increase in trading profits.

Chairman, Sir Harry Jephcott, reports that while profitability has been more than maintained when comparison is made with that of the immediately preceding six months, it is not inferred that further improvement will be possible during the current half year. Conditions in a number of overseas markets are stated to be difficult, and restrictions upon importations have been imposed in certain instances.

William Gossage

William Gossage and Sons (controlled by Unilever) report a net profit for 1957 of £186,482 (£196,327). Net current assets are £3,681,835 (£277,543), and the surplus on sale of shares in fellow subsidiaries to holding company is £1,319,099 (nil).

Revertex Ltd.

Manufacturers and sellers of concentrated rubber latex and synthetic resin emulsion, report another satisfactory year. Deliveries of Revertex (concentrated rubber latex) showed a further increase in the year ended 30 September last. Tests on a pilot plant scale on latex from a main rubber growing area of Africa are now being carried out. If these prove satisfactory, a full-scale production unit will be set up.

Deliveries of Emultex (polyvinyl acetate emulsion) were slightly greater than for the previous year. A considerable export business has been built up for this product in the Union of South Africa. A suitable site has therefore been bought near Durban and a small factory is being erected. To conduct operations in the Union, Revertex (South Africa) Proprietary Ltd., has been formed. Alcotex (polyvinyl alcohol) has made a 'small but welcome contribution' to the company's profit during the past year and the new plant is now operational.

A note on the company's trading profits, etc., appeared in CHEMICAL AGE, 8 March, p. 470.

Monckton Coke

An offer of 47s 6d in cash per 1s share for the whole of the issued capital of Monckton Coke and Chemical Co. has been made to the company's chairman by certain interested parties. The offer is conditional upon 90 per cent acceptance or such lesser percentages as the interested parties shall elect.

It is reported that the board are considering this offer and as soon as a decision has been reached shareholders will be informed.

INCREASE OF CAPITAL

INDUSTRIA (ORE & CHEMICALS) LTD., 48 Dover Street, W1. Increased by £4,900, in £1 shares, beyond the registered capital of £100.

LONDON GAZETTE

Voluntary Winding-Up

(A resolution for the voluntary winding-up of a company does not necessarily imply liabilities. Frequently it is for purposes of internal reconstruction and notice is purely formal.)

CLECKHEATON CHEMICAL CO. LTD., and BIERLEY CHEMICAL CO. LTD., chemical manufacturers, regd. office, Iron Street, Westgate, Cleckheaton, Yorks. By special resolution, 19 March. Mr. R. M. Jones of Laporte Acids Ltd., Leeds 10, appointed liquidator.

Ultrasonics for Fluid Measurement in Pipes

ULTRASONIC systems for external measurement of pressurised liquid within a pipe have been proposed recently by Navy researchers. Formulations for the flowmeters, which could have application in chemical plants and nuclear reactors, are described in a report PB 131079, 'The feasibility of using wholly external ultrasonics to measure fluid flow within thick-walled metal pipes,' by V. A. Del Grosso and E. M. Spurlock, Naval Research Laboratory, Nov. 1957, available from Office of Technical Services, US Department of Commerce, Washington 25, price $1.25.

The research was undertaken after a literature survey disclosed no proven ultrasonic scheme in which the sound energy traverses fairly thick metal walls between sound source and receiver and the liquid. A flowmeter operating through pipe walls could be used where liquid is corrosive or is contained under high pressure or at high temperatures.

Three proposed configurations for the flowmeter are described. A block diagram for the electronics system is suggested, along with a scheme to minimise the effect of sound speed on the flow indication. A scheme for mechanical construction of two configurations is also included.

TRADE NOTES

A HIGH pressure processes division has been set up by Woodall-Duckham Construction Co. with Mr. H. S. Cheetham as director-in-charge. The company say that the new division will concentrate upon the provision of complete plants for the production of gases suitable for town supply and chemical synthesis, using modern high pressure techniques.

Whiffen-ICI Trading Agreement

An arrangement has been made whereby Whiffen and Sons Ltd. and the 'Alfloc' water treatment service of Imperial Chemical Industries Ltd. will co-operate in the development in the UK of the use of 'Zerox' (35 per cent hydrazine solution) for the de-oxygenation of boiler feed water. Deliveries of 'Zerox' and technical advice on its use will be available from Whiffen and Sons Ltd., Fison House, 95 Wigmore Street, W1 or from ICI sales offices.

Borosilicate Tubing

Borosilicate thermometer tubing is now being produced by James Powell and Sons (Whitefriars) as a result of a series of experiments and tests. Previously this type of tubing was only available by importation from Germany and the US.

The company state that their tubing has good working properties and is suitable for making up into the commercial grade, high-range thermometers for prolonged immersion up to 500°C and for spot tests up to 550°C.

Rigidex Polythene

British Resin Products Ltd. state that the high density polythene which they are marketing on behalf of British Hydrocarbon Chemicals Ltd. will in future be sold under the trade mark Rigidex. Rigidex is made by the Phillips process, which is licensed to British Hydrocarbon Chemicals, a company jointly owned by the Distillers Co. and British Petroleum.

Mercer's New Premises

Thomas Mercer Ltd. have opened new premises in Old London Road, St. Albans, Herts, for the manufacture of standard and special air gauging units. These premises are additional to the expansion of the existing buildings at Redbourne.

Visco Engineering Co.

When describing the MV type filter made by Visco Engineering Co. on page 503 of our 15 March issue, we incorrectly stated that 'initial resistance at 625 c.f.m. is 0.09 per cent w.g.' This should have read, 'initial resistance at 625 c.f.m. is 0.09 inches w.g.'

Catalin Antioxidant

The Catalin Corporation of America announce the availability of their antioxidant CAO-5 (2, 2' methylene bis (4-methyl-6-tertiary-butyl phenol)), for use in white and light coloured rubber, rubber foams, tyres, elastic threads, drug and surgical sundries, footwear, bathing accessories, household goods and specialty applications. This material is said to exhibit excellent non-staining and non-discolouring antioxidant properties. Samples and information can be obtained from the UK distributors, Omni (London) Ltd., 35 Dover Street, London W1.

Cheaper Inclined Gauges

Walker, Crosweller and Co., Ltd., of Cheltenham, have recently reduced the prices of their 'Arkon' inclined gauges by from 12 per cent to 14 per cent. 'Arkon' gauges are available for pressure, draught or differential pressure measurement with overall ranges 1 in., 1.5 in., 2 in. or 3 in. w.g. These ranges can be subdivided between pressure and draught to meet customers' requirements, and can be scaled in inches w.g., millimetres w.g., or in terms of flow.

Anti-Moth Material

Permanent protection for all woollen goods against moths is claimed for Dielmoth, developed by Shell Chemical Co. This material has been used by carpet manufacturers for some time but its application had been extended to all articles which contain wool or other keratinous material.

Dielmoth is usually introduced directly into an acid dyebath where it readily exhausts itself on to the wool together with the dyestuffs themselves.

Silicone Price Reductions

Price reductions for MS 200 silicone fluids and Releasil fluid are announced by Midland Silicones Ltd., 19 Upper Brook Street, London W1. For MS 200 fluids in the range 50 cS to 1,000 cS price cuts will vary from 1s 3d to 1s 6d a pound according to quantity. Larger cuts have been made for fluids of other viscosities in the range 0.65 cS to 20 cS and of 12,500 cS and up.

Price cuts for Releasil fluid will save buyers up to 1s 6d a pound according to quantity.

Improved Lacquer Curing

Lacquers with improved curing rates can be obtained, claim Imperial Chemical Industries Ltd., paints division, by the use of Suprasec K, a 50 per cent solution of a polyisocyanate in ethyl acetate.

Daltolac 9, 10 and 11 lacquers all show increased speed of dry with no decrease of pot life. Applications envisaged are in wood lacquers, rubber lacquers, paints with high chemical resistance, and highly resistant coatings for other purposes.

Change of Name and Address

The trading name of Horace Priest Chemical Engineering Co. Ltd. has been changed to the Beverley Chemical Engineering Co. Ltd., and their new address is at Beverley House, London Road, Horsham, Sussex, telephone Horsham 3211/2. The company make heat exchange, fluid heat and distilling units, mixing equipment, dewatering machines and float control valves.

Distillers Co. Divisions Merged

The Distillers Co. Ltd. have merged the activities of its carbon dioxide, industrial alcohol and British industrial solvents divisions in the field of industrial chemicals into a single chemical division with headquarters at Devonshire House, Mayfair Place, Piccadilly, London W1. Management, production, control, purchasing and accounting are now centralised, but sales will continue to be handled by separate departments.

Change of Address

Erinoid Ltd. will be moving their London sales office, on 12 April from: 96–97 Piccadilly, London W1 to West Halkin House, West Halkin Street, Belgrave Square, London SW1. Telephone: SLOane 0866.

Keebush Diaphragm Pump

Leaflet 301, which details the Keebush diaphragm pump, has been issued by the Kestner Evaporator and Engineering Co. Ltd., 5 Grosvenor Gardens, London SW1. In this pump, which is glandless, self-priming and suitable for acids and acid slurries, the body is of Keebush synthetic resin and the diaphragm and ball valves of synthetic rubber and flexible plastics.

Market Reports

Enquiries for New Business 'Satisfactory'

LONDON The movement to the home consuming industries has been well maintained although deliveries will be temporarily interrupted by the Easter holidays. Enquiries for new business during the past week have been on a satisfactory scale with interest mainly concerned with spot needs. Buying for shipment continues on a broad basis covering most sections of the market.

No outstanding price changes have been reported, and the increase in the quotation for sulphate of copper recorded in last week's British Chemical Prices is understood to date from 25 March.

There has been no alteration in conditions in the coal-tar products market either as regards supplies or demand, and prices throughout this section remain steady.

GLASGOW The Scottish heavy chemical market remains unaltered, although towards the end of the week there was some little improvement. In heavy industries demands have been reasonably well maintained, while the textile industry has shown a tendency to be rather quieter. On the whole, prices have remained steady, with little or no alteration taking place. The export market continued at a good level, with the usual varied range of enquiries being received. In regard to agricultural chemicals, some increased activity is reported in the agricultural market.

MANCHESTER The past week has seen little change in trading conditions, although there are indications of pre-holiday quietness developing. Most industrial consumers have drawn satisfactorily against contracts and in the early days of the week a fair number of enquiries were circulating on both home and export accounts. Shipping business in most sections remains at a good level. With an odd exception steady to firm price conditions have again been reported. Seasonal activity is a feature of the fertiliser market and tar products generally are quietly steady.

NEW PATENTS

By permission of the Controller, HM Stationery Office, the following extracts are reproduced from the 'Official Journal (Patents)', which is available from the Patent Office (Sale Branch), 25 Southampton Buildings, Chancery Lane, London WC2, price 3s. 3d. including postage; annual subscription £8 2s.

Specifications filed in connection with the acceptances in the following list will be open to public inspection on the dates shown. Opposition to the grant of a patent on any of the applications listed may be lodged by filing patents form 12 at any time within the prescribed period.

AMENDED SPECIFICATION

Copies will be on sale 30 April or as soon as possible thereafter

Thiazole derivatives. Kodak, Ltd. **759 810**

ACCEPTANCES

Open to public inspection 30 April

Preparation of benzene hexachloride compositions. Columbia - Southern Chemical Corp. **794 374**

Aromatic sulphonium compounds and a process for their production. Farbenfabriken Bayer AG. **794 066**

Preparation of alcohols. Imperial Chemical Industries, Ltd. **794 067**

Method and apparatus for the addition of magnesium or the like to an iron melt. Lips N.V. **794 287**

Process for effecting nuclear fission reactions. Stichting Reactor Centrum Nederland. [Addition to 755 495.] **794 224**

Chlorinated hydrocarbons. Soc. d'Electro-Chimie, d'Electro-Metallurgie et des Acieries Electriques d'Ugine. **794 378**

Flash evaporating and condensing systems. Shepherd, G. R. (Westinghouse Electric International Co.). **794 379**

Oils. Shell Research, Ltd. **794 380**

Brominated organic acid. U.C.L.A.F. **794 381**

Purification of glycols. Imperial Chemical Industries, Ltd. **794 382**

Process for the production of azulenes. Ziegler, K. [Addition to 750 209.] **794 383**

Nitrosoarylenediamines and compositions containing same. Monsanto Chemical Co. **794 073**

Steroid compounds and processes for their manufacture. Schering Corporation. **794 385**

Production of halofluoroacetones. Allied Chemical & Dye Corn. **794 075**

Recovery of useful products from used sulphuric acid pickling baths. A.R.B.E.D. Acieries Reunies de Burbach-Eich-Dudelange Soc. Anon. **794 386**

Extreme pressure grease composition. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. **794 387**

Process for the aluminothermic preparation of boron, borides and boron-containing alloys by reduction. Andrieux, J-L., and Peffen, R. **794 146**

Removing an acidic component from a fluid stream. Universal Oil Products Co. **794 389**

Process for the production of oxalate coatings on ferrous metals. Montecatini Soc. Generale per l'Industria Mineraria e Chimica. **794 294**

Granular catalyst and process for sweetening a sour petroleum distillate employing said catalyst. Standard Oil Co. **794 295**

Hydroxyaryl-substituted acid-esterfied acid esters and method of making same. Johnson & Son, Inc., S. C. **794 229**

Process for the production of cobalamines by fermentation of culture broths with nocardia sp. (Nocardia-rucosa). Soc. Farmaceutici Italia. **794 151**

Process for alkylating aromatic compounds. Universal Oil Products Co. **794 153**

Steroid compounds and the preparation thereof. Pfizer & Co., Inc., C. **794 392**

Preparation of gamma- (aryloxy) butyric acids. Imperial Chemical Industries of Australia and New Zealand, Ltd. **794 156**

Steroid compounds and process for their production. Upjohn Co. **794 394**

Substituted piperidine-4-carboxylic esters. Merck & Co., Inc. **794 159**

Plant growth control and herbicidal composition and process of using same. Chipman Chemical Co., Inc. **794 395**

Manufacture of fibre-glass. Owens-Corning Fiberglas Corporation. **794 302**

Process for the production of acetylene and ethylene. Monsanto Chemical Co. **794 157**

Method of bending glass sheets. Pittsburgh Plate Glass Co. **794 305**

Preparation of steroid compounds. Pfizer & Co., Inc., C. **794 158**

Organic nitrogen compounds and process for producing same. Parke, Davis & Co. **794 239**

Production of spinning solutions from polyacrylonitrile and acrylonitrile copolymers. Vereinigte Glanzstoff-Fabriken AG. **794 396**

Method of producing N-substituted products of 2, 4-diamino-1, 3, 5-traizine. Groth, I., [trading as Heumann & Co., L.]. **794 398**

Rubber-and-resin compositions. United States Rubber Co. **794 400**

Liquefied m-phenylenediamine compositions for curing epoxy ether resins. Fairweather, H. G. C. (General Aniline & Film Corp.). **794 165**

Method and apparatus for producing fibres from heat-softenable fibre-forming mineral materials. Owens-Corning Fiberglas Corp. **794 319**

Method of producing glass film or flake. Owens-Corning Fiberglas Corp. **794 322**

Production of calcium. Andrieux, J-L., and Bonnier, E. **794 327**

Process for the polymerisation of vinyl compounds. Vereinigte Glanzstoff-Fabriken AG. [Addition to 763 900.] **794 169**

Organohalogenomonosilanes. General Electric Co. **794 086**

Adhesive bonding and compositions comprising synthetic resinous material for use therein. B.B. Chemical Co., Ltd. [Divided out of 793 444.] **794 088**

Reactors for catalytic conversion of hydrocarbons. Houdry Process Corp. [Divided out of 794 089.] **794 090**

Treatment of cellulose textile materials. Imperial Chemical Industries, Ltd. [Divided out of 794 180.] **794 181**

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Process for separating uranium. Boyer, R. Q., and Kilner, S. B. **794 490**

Processes for the production of pure germanium and silicon. Kirby, H. D. B. (Siemens & Halske AG). **794 641**

Insolubilisation of cellulose ethers. Johnson & Johnson. **794 565**

Manufacture of dehydrogenation compounds of the pregnane series. Ciba Ltd. **794 422**

Liquid containers. Graviner Manufacturing Co., Ltd., and Wilkinson Sword, Ltd., formerly Wilkinson Sword Co., Ltd. [Cognate application 7030.] **794 720**

Chloro-methylene tetrahydroindanes and a process for their production. Ruhrchemie AG. **794 661**

Production of condensation products of styrene oxide. Deutsche Gold- und Silber-Scheideanstalt Vorm. Roessler. **794 644**

Cation-exchange resins. Asahi Chemical Industry Co., Ltd. **794 426**

Method and rubber compositions for manufacture of belts. Polymer Corporation, Ltd. **794 502**

Manufacture of soap. Unilever, Ltd. **794 428**

Process for the preparation of conversion products of the higher carbohydrates and/or carbohydrate ethers. Naamlooze Vennootschap Eldeka. **794 569**

Valves for fluids. Taylor, F. R. **794 665**

Apparatus for the distribution of gases. British Titan Products Co., Ltd. **794 666**

Alkylation of aromatic hydrocarbons. Imperial Chemical Industries, Ltd. **794 570**

Aromatic-hydrocarbon-aldehyde resins. General Electric Co. **794 646**

Removal of excess water from aqueous slurries or suspensions. Service (Engineers), Ltd. **794 733**

Preparation of α-dihydroionone. Firmenich, A., Firmenich, R., Firmenich, G., and Firmenich, R. [trading as Firmenich & Co., Successeurs de la Soc. Anon, M. Naef & Cie]. **794 416**

Octahydronaphthal derivatives, compositions of matter containing said derivatives and their process of preparation. Firmenich, A., Firmenich, R., Firmenich, G., and Firmenich R., [trading as Firmenich & Co., Successeurs de la Soc. Anon. M. Naef & Cie.]. **794 417**

Recovering basic antibiotics, by adsorption on cation exchangers. Olin Mathieson Chemical Corp. **794 436**

Photopolymerisable compositions and printing plates containing them. Gestetner, Ltd. **794 572**

Solid oil-containing compositions. Unilever, Ltd. **794 514**

Recovery of tetracycline from fermentation broths. Bristol Laboratories, Ltd. **794 738**

Hydrosulphurisation process. Esso Research & Engineering Co. **794 576**

Coating of polymeric thermoplastic dielectric film. Du Pont de Nemours & Co., E. I. **794 581**

Metallic halides. Horizons Titanium Corp. **794 518**

Bonding of zirconium to other metals. UK Atomic Energy Authority. **794 671**

Process for the manufacture of raw materials for lacquers. Farbenfabriken Bayer AG. **794 585**

Rust preventative composition. Esso Research & Engineering Co. **794 586**

Preparation of dithiophosphate esters. American Cyanamid Co. **794 597**

Filtration of liquids. Yarrow & Co. Ltd. **794 446**

Recovery of hard metal carbides. Nussbaum, L. **794 602**

Preparation of tertiary-aminoalkyl aminoalkoxybenzoates. Sterling Drug, Inc. **794 754**

Polyurethane plastics: method of making. Farbenfabriken Bayer AG **794 755**

HYCAR IN PHENOLIC RESIN ADHESIVES

THE USE of Hycar 1001 (British Geon Ltd.) with the special phenolic resin Cellobond H833 (British Resin Products Ltd.) is described in a British Geon report. Hycar nitrate rubbers with a high acrylonitrile content are used with special phenolic resins in the preparation of high performance adhesives for bonding many types of products including metal to metal. Such adhesives are designed primarily for hot setting, but they can be used successfully in many cold setting applications.

Although the ratio of rubber to resin can be varied within wide limits it is usually between 2:1 and 1:2. Higher ratios of rubber are used when bonding flexible surfaces and higher resin contents are recommended for rigid materials. Information sheet No. H 105 provided by the British Geon Ltd., gives formulations for the various types of adhesives and the method of preparation as well as the methods of application. Formulation No. 1 is a general purpose adhesive, No. 2 is a rigid adhesive suitable for bonding metal and Nos. 3 and 4 are flexible adhesives for bonding rubber, leather and flexible plastics.

Formulation No.	1	2	3	4
Hycar 1001 ...	100	100	100	100
Cellobond H.833 ...	100	140	50	40
Hexamine ...	10	14	5	4
Methyl ethyl ketone ...	210	254	155	144

Two methods of preparation can be used. In one, the resin and hexamine are added to the rubber using a two-roll mill and the master batch is subsequently dissolved in methyl ethyl ketone (MEK). In the second method, a solution of the rubber in MEK is blended with a solution of resin and hexamine. The Hycar should in this case first be masticated to a Mooney viscosity of 65 to 75 to ensure uniform solution.

Adhesives based on the Hycar 1001 are said to give excellent bond strengths.

New B S Contains Powder Definitions

POWDER is defined as 'discrete particles of dry materials of size less than 1,000 microns maximum dimensions' in a new British Standard (2955:1958). Following this definition are sections containing terms associated with types of powder, particle size, particle shape, powder properties and powder processing.

Two appendixes deal with mean diameters of particulate systems and calculation of Stoke's diameter. Copies from BSI, Sales Branch, 2 Park Street, W1.

PT Exemption for Drugs and Medicines

THE schedule of essential drugs and medicines exempt from purchase tax has been extended by a Treasury Order under the Finance Act 1948, section 21.

Under Head II of the Schedule: Aluminium dimagnesium trisilicate, whether or not mixed with hyoscyamine, hyoscine, apoatropine and belladonnine; p-n-butylaminobenzoic (nona-ethyleneglycol methyl ether) ester; the molecular compound of chloral hydrate and phenazone; 5-chloro-2-(p-diethylaminoethoxyphenyl) benzothiazole hydrochloride; chlorothiazide; dihydroxyaluminium sodium carbonate, whether or not mixed with calcium carbonate; N-ethyl-N'-(5-nitro-2-thiazolyl) urea; the entry for hormones and synthetic compounds with hormone activity which appeared in the Purchase Tax (No. 2) Order 1957 is extended to include the carbon ring system of oestr-5(10)-ene; mannomustine, and salts thereof; narcotine, and salts thereof.

Under Head III of the Schedule: 1-(2-hydroxyethyl)-4-[3-(2-chloro-10-phenothiazinyl)-propyl]piperazine, and salts thereof; N-methylpipecolin-2:6-xylidide hydrochloride; vanilloyldiethylamide.

All drugs and medicines previously exempt under the revoked order remain exempt under the new order but certain of the drugs now appear under the name approved by the British Pharmacopoeia Commission.

The order applies to goods which are despatched on sale by registered traders to unregistered traders or appropriated to retail trade or similar purposes by a registered trader on or after 1 April 1958, and to imported goods entered with the Customs or delivered from bonded warehouses for home use on or after that date.

Copies of the order are obtainable (price 6d net, by post 8d) from HM Stationery Office, Kingsway, London WC2 and branches, or through any bookseller.

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